A Guide to the Identification of Poplar Clones in Ontario

Ontario
Ministry of Natural Resources
Hon. Alan W. Pope
Minister
John R. Sloan
Deputy Minister

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Foreword

The Ontario Ministry of Natural Resources' hybrid-poplar plantation program is becoming well-known throughout Canada. It is a cash-crop program suited to a variety of sites and conditions, and it produces a wide range of products such as timber, fiber for pulp and composite boards, energy, food, forage, and chemical feed-stock.

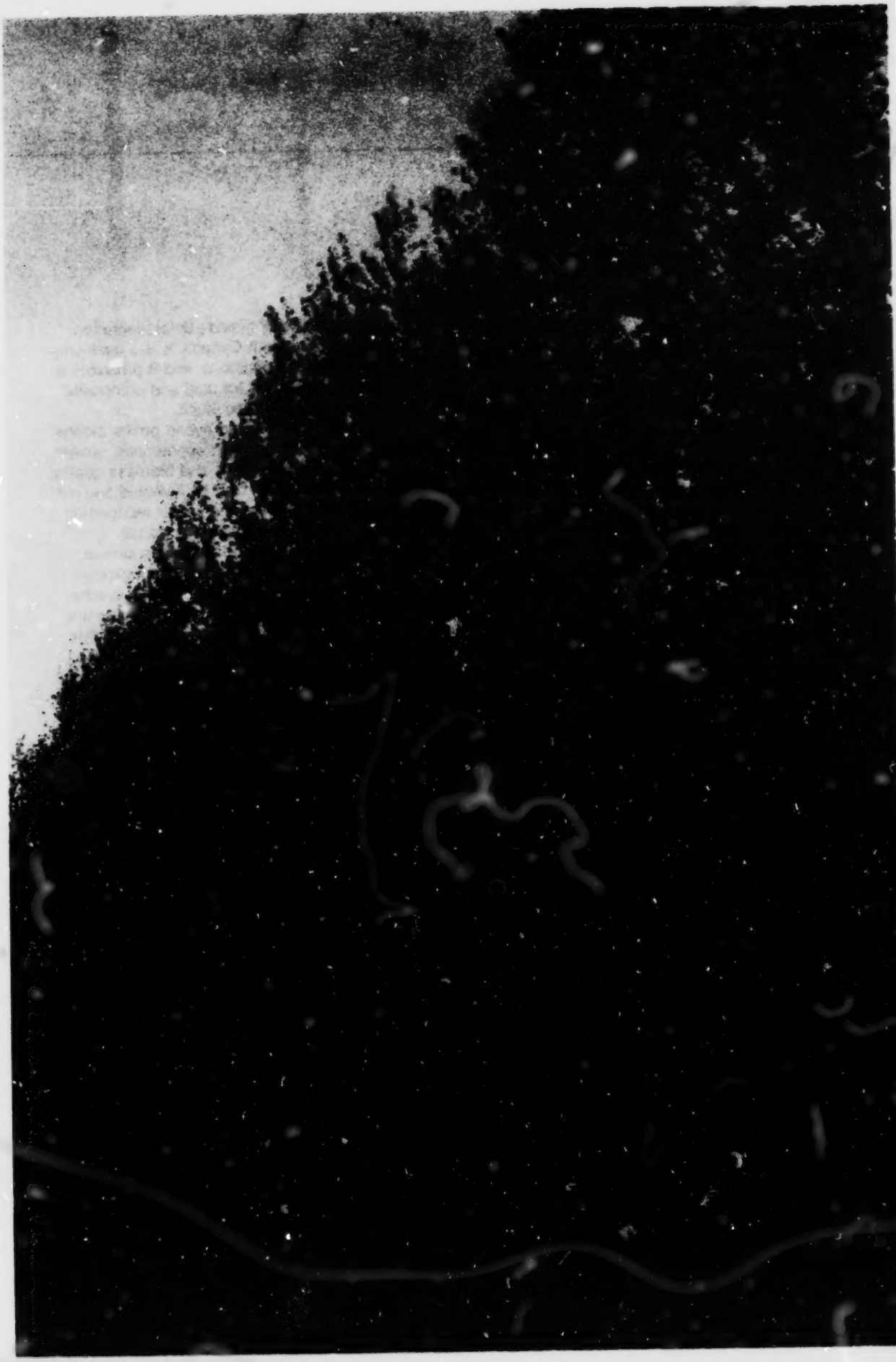
Genetically improved and carefully selected hybrid poplar clones are the program's cornerstone. The clones vary in appearance, growth, adaptation to sites, resistance to frost and pests, and biomass quality. In order for the program to succeed, clones must be selected and matched to both sites and production objectives. The proper recognition and identification of clones is therefore of critical importance.

Because species parentage of many hybrid poplars is similar, many of the clones selected for this guide appear morphologically similar to the untrained eye. However, they vary significantly in other characteristics important for production. Therefore, specific keys and guidelines for proper clonal identification have been included in this publication. The guidelines highlight taxonomical and phenological features and are an indispensible aid to recognizing clonal identity as well as maintaining and certifying clonal purity.

Dr. Roller has developed this guide in association with the Ontario Tree Improvement and Forest Biomass Institute of the Ministry of Natural Resources. The Institute's forest-genetics and tree-breeding programs are credited for the genetic improvement of poplars and selection of hybrid poplar clones. The clones described herein represent a number of those recommended for commercial use in Southern and Central Ontario. Although some of the clones originated in Europe and the United States, all of those described have been selected and tested for their performance in Ontario.

This guide, which fills a much felt need in poplar literature, has been written and designed to assist both specialist and lay persons active and interested in the many aspects of poplar science, culture, and production.

Louis Zsuffa
Principal Scientist
Ontario Tree Improvement and Forest Biomass Institute



Introduction

A Guide to the Identification of Poplar Clones in Ontario has been prepared for poplar growers in order to provide them with a practical classification tool. It has been our aim to develop a simple and precise key for the identification of thirty-two different Ontario-grown poplar clones, using photographs and illustrations to distinguish their characteristics.

Some of the hybrids presented have been bred locally—by cross fertilization—while others were selected from open-pollinated offspring. We have purposely not placed much emphasis on the origins of foreign clones selected as their characteristics have changed with the different ecologic conditions of Ontario. Instead, Ontario code numbers have been applied to each clone for general reference.

It is difficult to develop a simple and precise key for the identification of hybrid poplar clones, particularly when the hybrids originate from the same parentage (as is the case in the hybrids of *Populus x euramericana*). During sexual reproduction, the chromosomal arrangements of the two parent species produce enormous variations in the offspring. This high variability of characteristics was of concern during the research. Therefore, a minimum of twenty samples was taken for each plant part and for each clone, to ensure reliability of the data.

The first quarter of this guide deals with the diagnostic aspects of the parts of a tree. As a visual guide, a "family tree" of poplar leaves is also included in this section, consisting of a written breakdown of the five types of poplar leaves and photographs of each of the particular poplar leaves studied in this survey. It can be used as a conveniently quick way to narrow down the clone type of any poplar tree. The remainder of the book provides detailed morphological descriptions of the thirty-two clones.

Three appendices have been included at the end of the guide which are of particular value in trying to assess the specific type of a tree. A glossary of scientific terms is also included for clarification of botanical terms.

Leaves

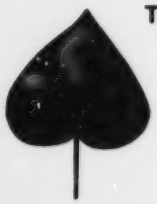
The leaves of poplar trees vary greatly in size and shape. Therefore, always look for a typical leaf or a variety of types that appear on the same tree. Never be satisfied with the first leaf within reach.

The location of the leaf samples on the stem is essential. It is known, for example, that heterophilia exists on each long shoot of the nursery stock. Two kinds of leaves develop—early and late. The early leaves grow from the buds developed before leaf fall, and the late leaves develop during the winter. Late leaves are used to determine leaf characteristics because they are more consistent in size and shape than are early leaves, and they have a stronger genetic linkage to the parent trees. Thus, the leaf samples reproduced in this guide were collected during August from the leaders of nursery stock (that is, the late leaves of long shoots) at the eighth to tenth leaf buds, counting from the tip of the leader. They are examples of the most typical leaves of single clones. At this location, the shape of the leaf scar is also distinct.

On the following pages there is a detailed breakdown of five categories of poplar leaves: oval or ovate; deltoid; deltoid with a straight base; deltoid with a broadly cuneate base; and rhomboid or rhombo-deltoid. By comparing hybrid poplar leaves with the descriptions and photographs that follow, the clonal variety of the leaves can be assessed.

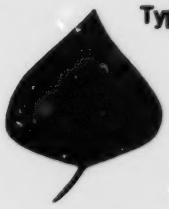
Leaf Shapes for Classified Clones

Type 1 Oval or ovate
Clones:
Jackii 4
Jackii 34
DTAC-2

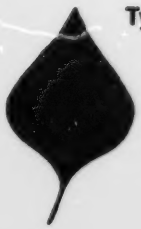


Type 2 Deltoid
Clones:
DN 14
DN 15
DN 21
DN 36
DN 70
I-45/51

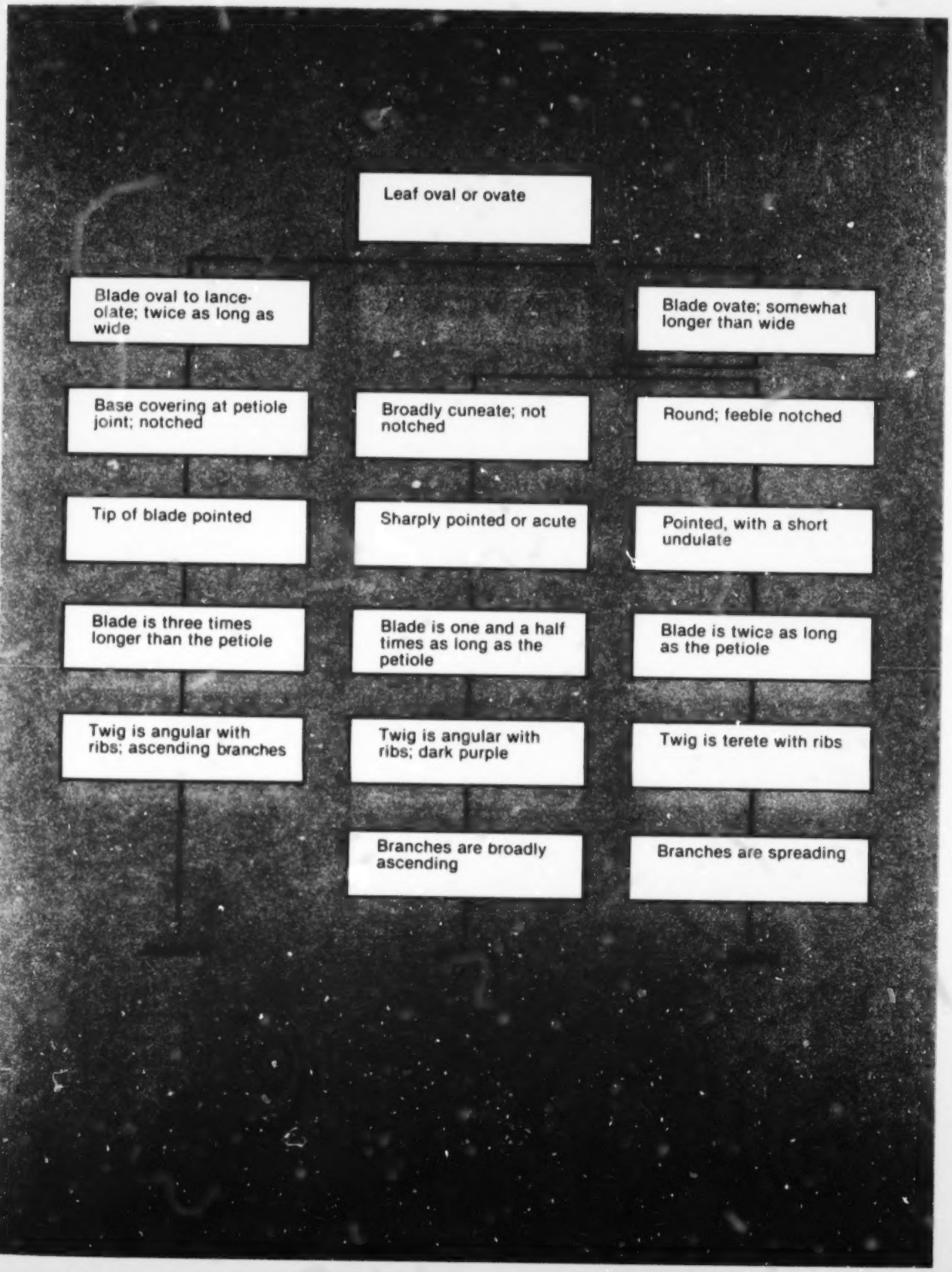
Type 3 Deltoid with straight base
Clones:
DN 1
DN 2
DN 5
DN 9
DN 10
DN 25
DN 55
DN 74
DTAC-1

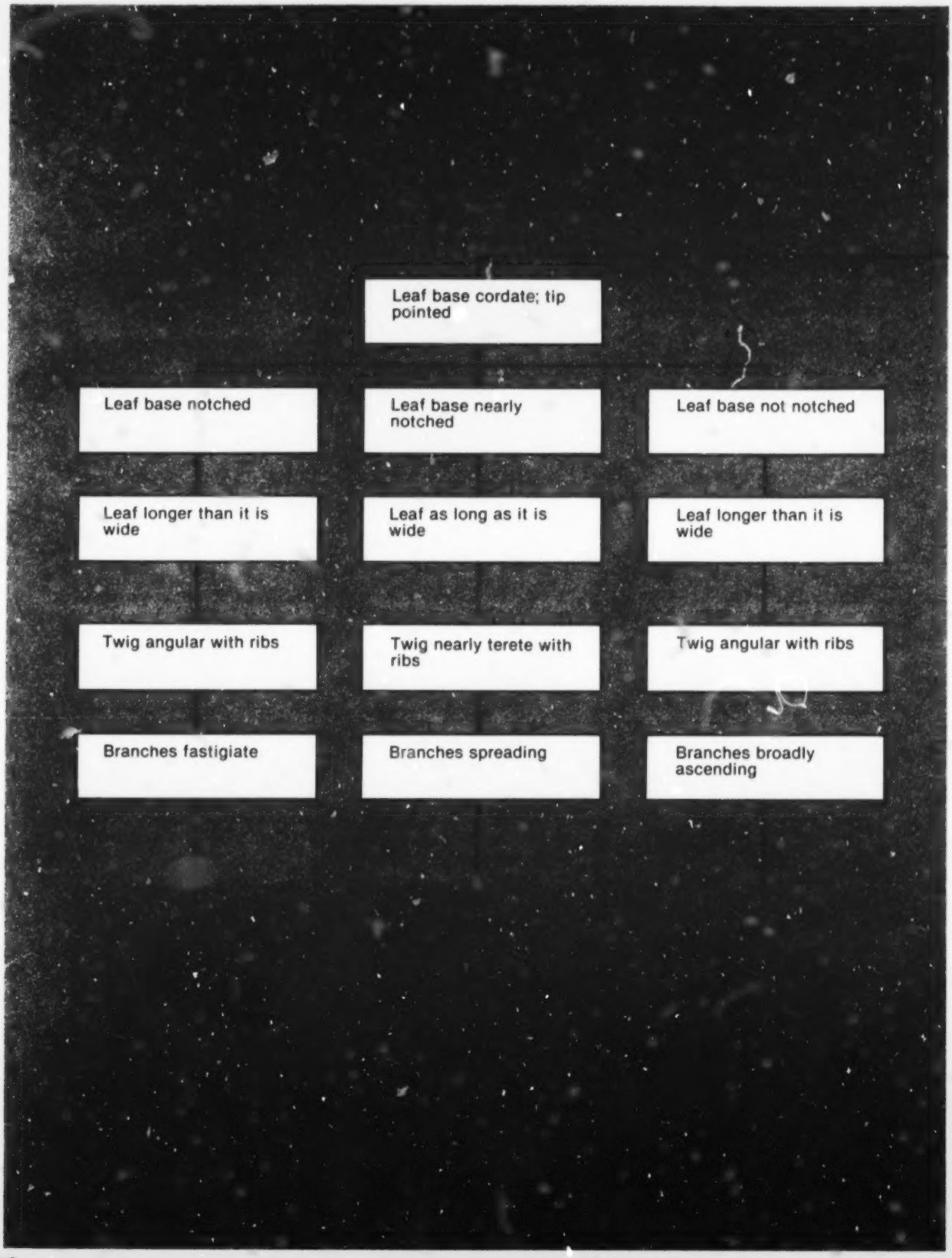


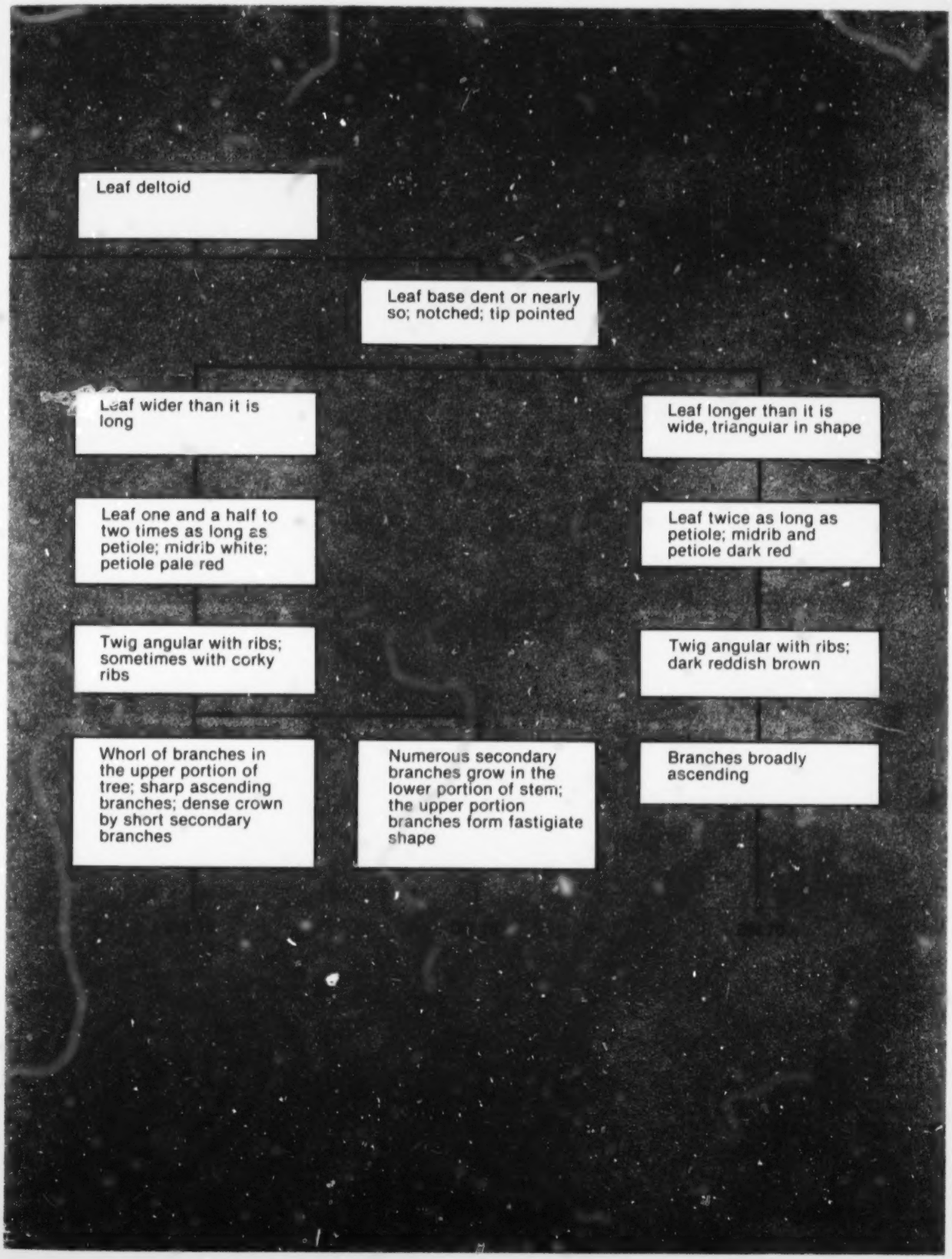
Type 4 Deltoid with a broadly cuneate base
Clones:
DN 7
DN 17
DN 19
DN 22
DN 28
DN 30
DN 31
DN 34
DN 38



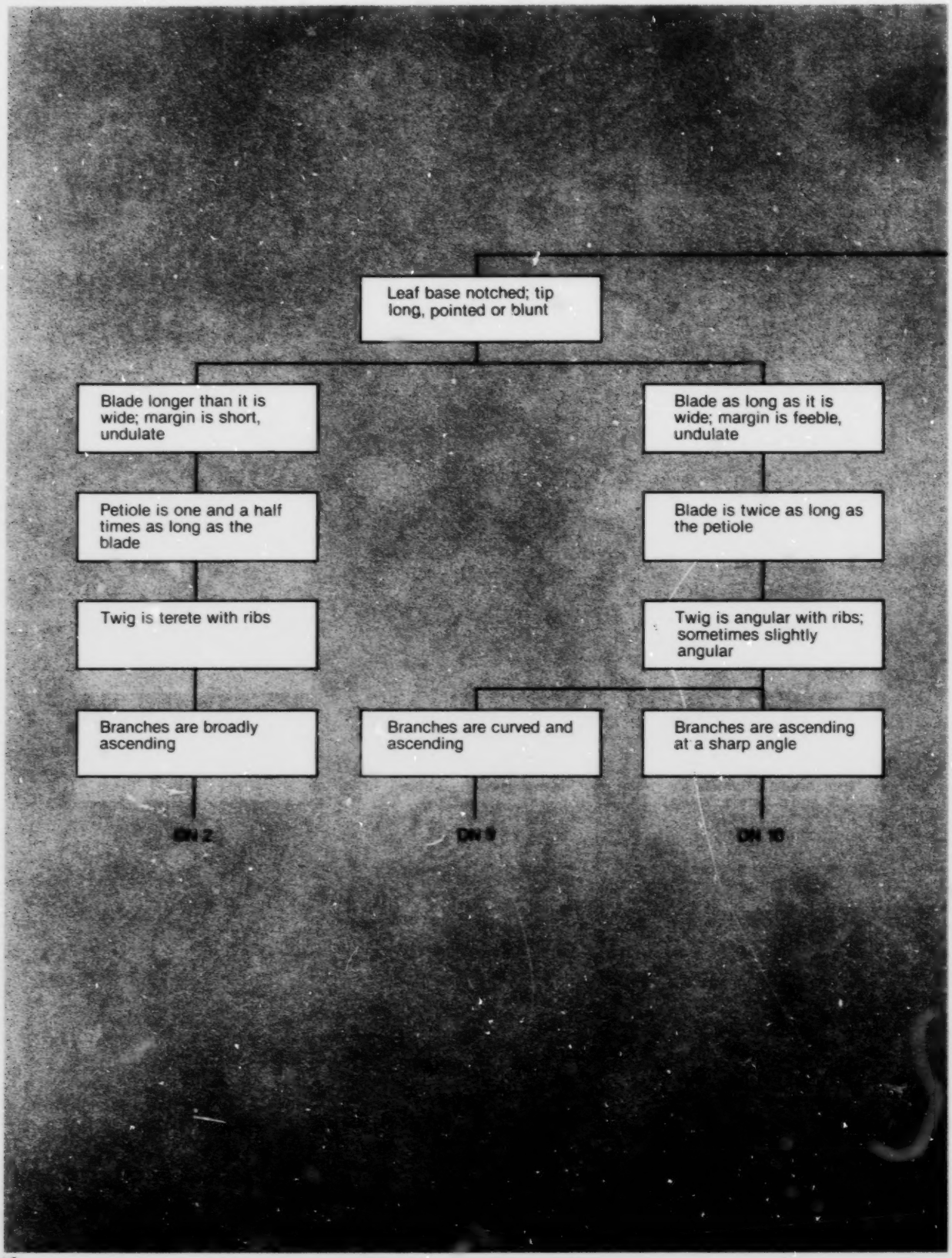
Type 5 Rhomboid or rhombo-deltoid
Clones:
DN 16
DN 18
DN 33
D 38
Jackii 30


Leaf oval or ovate
Blade oval to lanceolate; twice as long as wide
Blade ovate; somewhat longer than wide
Base covering at petiole joint; notched
Broadly cuneate; not notched
Round; feeble notched
Tip of blade pointed
Sharply pointed or acute
Pointed, with a short undulate
Blade is three times longer than the petiole
Blade is one and a half times as long as the petiole
Blade is twice as long as the petiole
Twig is angular with ribs; ascending branches
Twig is angular with ribs; dark purple
Twig is terete with ribs
Branches are broadly ascending
Branches are spreading


Type 2
Leaf base cordate; tip pointed
Leaf base notched
Leaf base nearly notched
Leaf base not notched
Leaf longer than it is wide
Leaf as long as it is wide
Leaf longer than it is wide
Twig angular with ribs
Twig nearly terete with ribs
Twig angular with ribs
Branches fastigiate
Branches spreading
Branches broadly ascending


Leaf deltoid
Leaf base dent or nearly so; notched; tip pointed
Leaf wider than it is long
Leaf longer than it is wide, triangular in shape
Leaf one and a half to two times as long as petiole; midrib white; petiole pale red
Leaf twice as long as petiole; midrib and petiole dark red
Twig angular with ribs; sometimes with corky ribs
Twig angular with ribs; dark reddish brown
Whorl of branches in the upper portion of tree; sharp ascending branches; dense crown by short secondary branches
Numerous secondary branches grow in the lower portion of stem; the upper portion branches form fastigiate shape
Branches broadly ascending

Type 3


Leaf base notched; tip long, pointed or blunt
Blade longer than it is wide; margin is short, undulate
Blade as long as it is wide; margin is feeble, undulate
Petiole is one and a half times as long as the blade
Blade is twice as long as the petiole
Twig is terete with ribs
Twig is angular with ribs; sometimes slightly angular
Branches are broadly ascending
Branches are curved and ascending
Branches are ascending at a sharp angle
DN 2
DN 9
DN 10

Leaf deltoid with straight base, or nearly so

Leaf base not notched

Blade wider than long; tip pointed or acute

Leaf blade twice as long as the petiole

Twig angular with ribs

Branches ascending at a sharp angle

DN 1

Petiole two-thirds the length of the blade

Twig angular with ribs

Branches curved and ascending; sylleptic branches are common

Blade longer than it is wide; tip acute; vein angle at 90°

Blade twice as long as the petiole

Twig feeble angular with ribs

Twig angular with strong ribs

Branches spreading; dense secondary branches appear

Branches ascending at a sharp angle

Leaf deltoid with straight base, or nearly so, not notched

Blade as long as it is wide

Short leaf tip, pointed or blunt

Blade twice as long as the petiole

Petiole two-thirds the length of the blade

Twig angular with ribs and twisted

Twig angular with fine ribs; sylleptic branchlets are common

Branches ascending at a sharp angle

Branches broadly ascending

Leaf tip acute or nearly so

Petiole length two-thirds of blade length

Twig terete, with fine ribs; leader may be feeble angular

Twig strongly angular with ribs

Branches ascending at a sharp angle

Branches ascending at a sharp angle

Leaf deltoid; blade as long as it is wide; base broadly cuneate, not lobed

Leaf tip pointed or blunt

Petiole length two-thirds of blade length

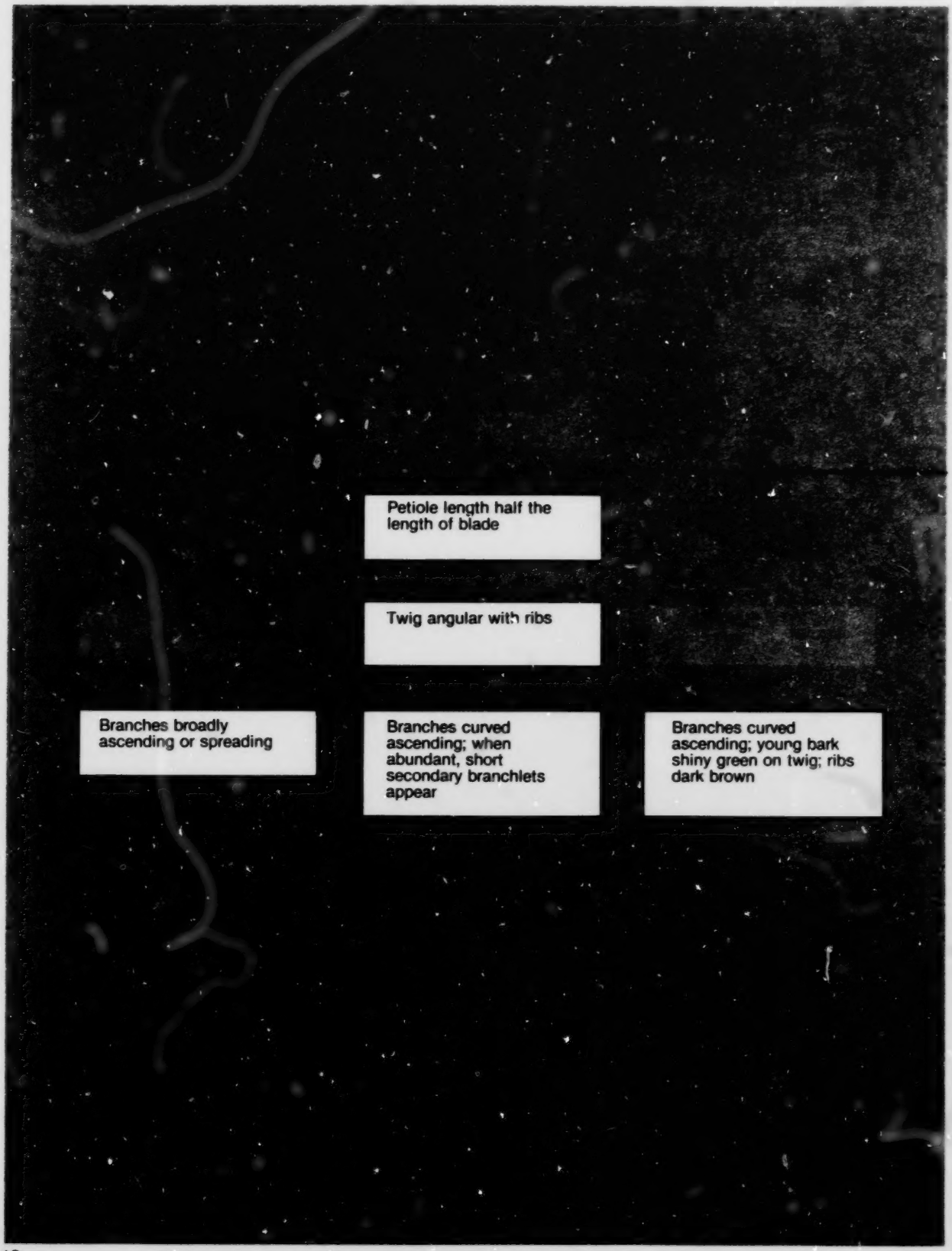
Twig terete or feeble angular

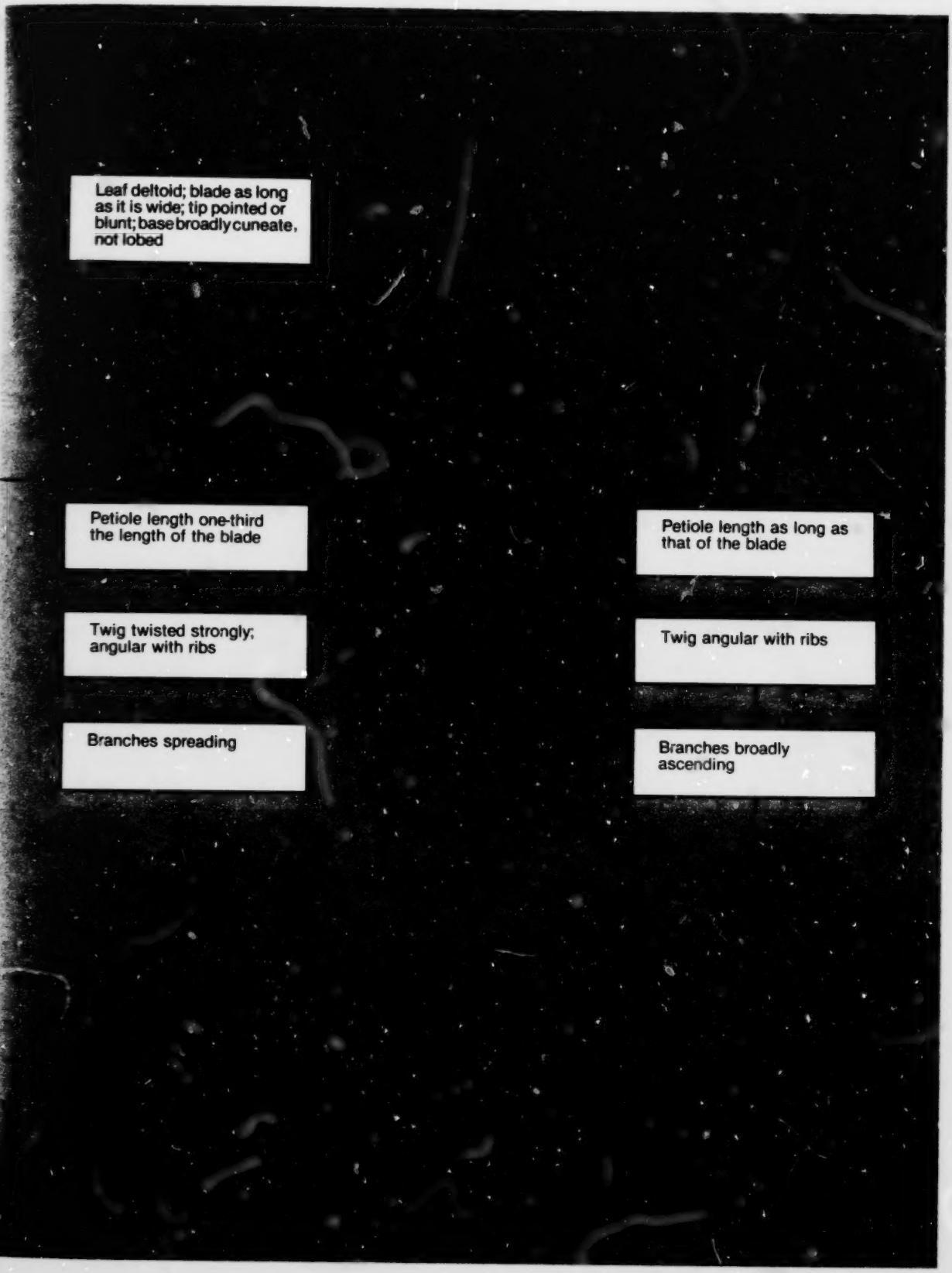
Twig strongly angular with fine ribs

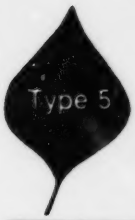
Branches ascending at a sharp angle

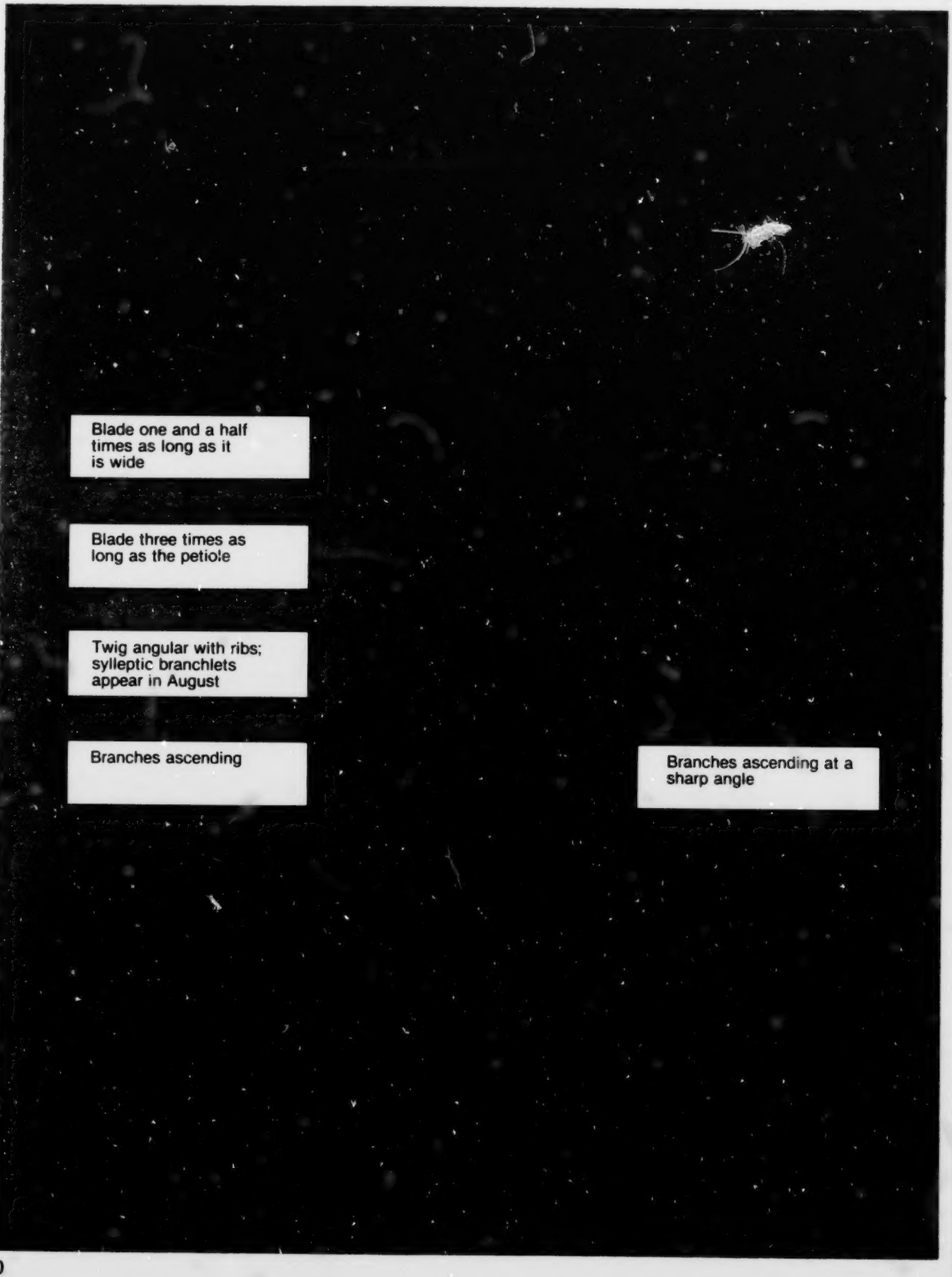
Branches broadly ascending

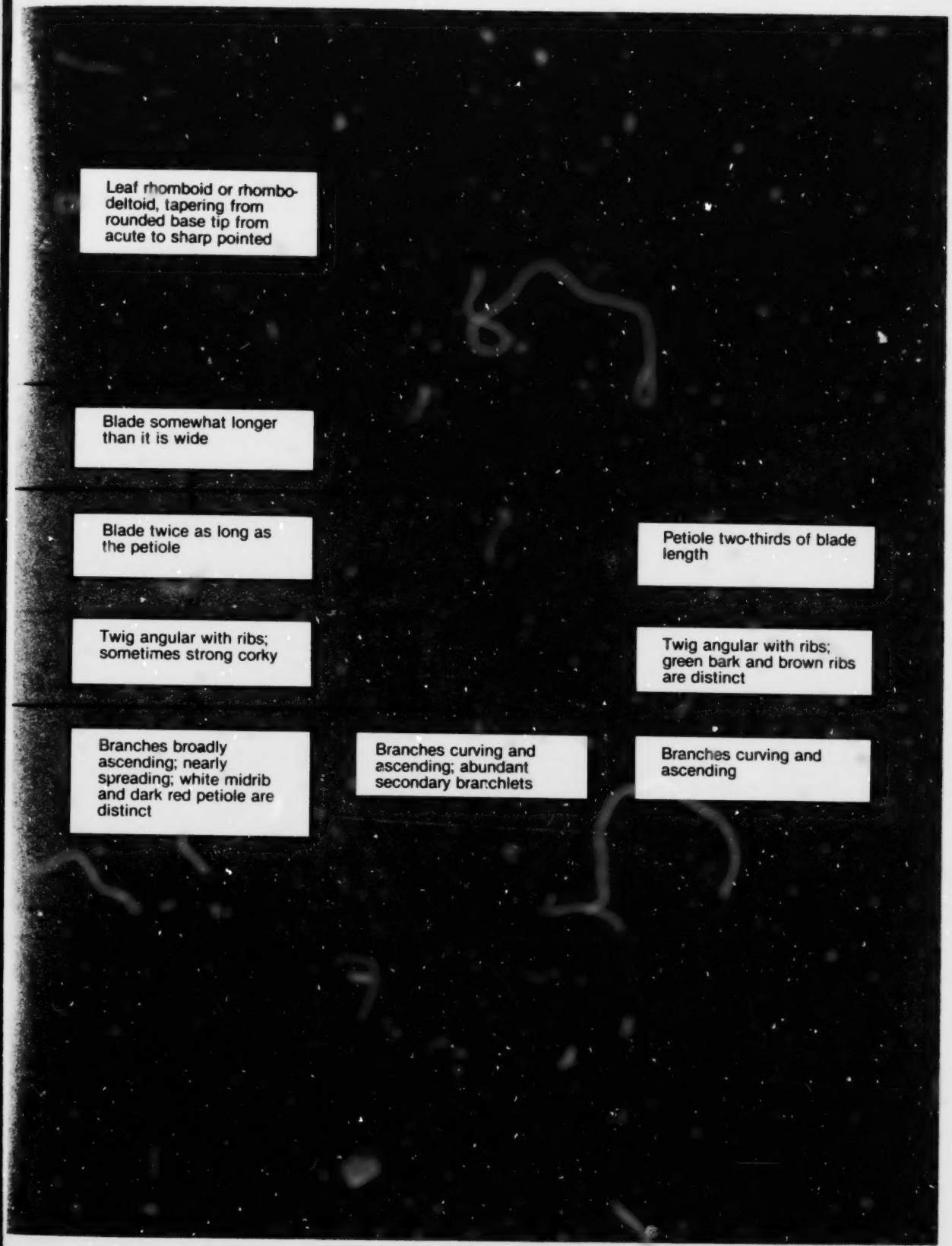
Type 4
cont'd


Petiole length half the length of blade
Twig angular with ribs
Branches broadly ascending or spreading
Branches curved ascending; when abundant, short secondary branchlets appear
Branches curved ascending; young bark shiny green on twig; ribs dark brown


Leaf deltoid; blade as long as it is wide; tip pointed or blunt; base broadly cuneate, not lobed
Petiole length one-third the length of the blade
Twig twisted strongly; angular with ribs
Branches spreading
Petiole length as long as that of the blade
Twig angular with ribs
Branches broadly ascending


Type 5


Blade one and a half times as long as it is wide
Blade three times as long as the petiole
Twig angular with ribs; sylleptic branchlets appear in August
Branches ascending
Branches ascending at a sharp angle


Leaf rhomboid or rhombo-deltoid, tapering from rounded base tip from acute to sharp pointed
Blade somewhat longer than it is wide
Blade twice as long as the petiole
Twig angular with ribs; sometimes strong corky
Branches broadly ascending; nearly spreading; white midrib and dark red petiole are distinct
Branches curving and ascending; abundant secondary branchlets
Petiole two-thirds of blade length
Twig angular with ribs; green bark and brown ribs are distinct
Branches curving and ascending

Twigs, Buds, and Leaf Scars

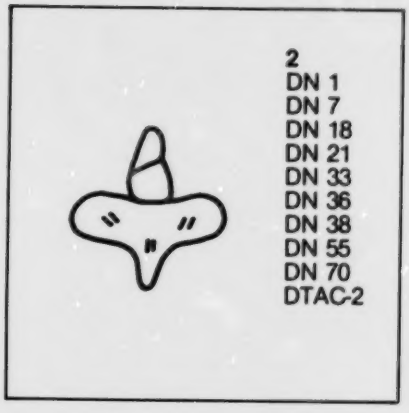
When selecting young shoots, pick healthy ones, and look at several whips before selecting any. Usually the leaders growing from the main stem are the best ones to pick. Remember when knifing the bark that, even in winter, live wood will be green under the bark.

To find this year's growth of stem, start at the tip of the whip and follow it back to the point at which the bark changes colour and texture. At this point there is usually a ring around the shoot. From here to the bottom end of the whip is the growth of the previous season. A young shoot has only buds along it, whereas two-year-old wood, which is lignified, usually has twigs branching off from it.

Special characteristics to be noted are: the size of the leaf scars and their position and shape; the bud position and size; and the shape of the lenticel and its spotting and dispersion.

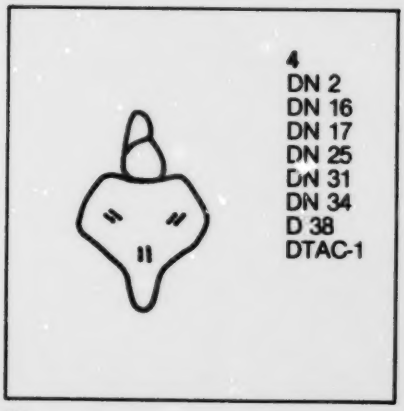
In the following illustrations of the prototypes of leaf scars, six classes are delineated. These classes are referred to in the morpholcgical descriptions of each clone.

1
DN 22
DN 30
Jackii 34



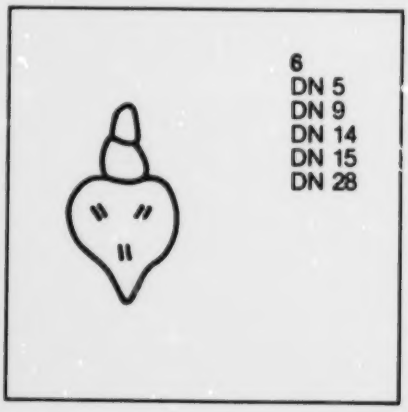
2
DN 1
DN 7
DN 18
DN 21
DN 33
DN 36
DN 38
DN 55
DN 70
DTAC-2

3
DN 19
Jackii 30



4
DN 2
DN 16
DN 17
DN 25
DN 31
DN 34
D 38
DTAC-1

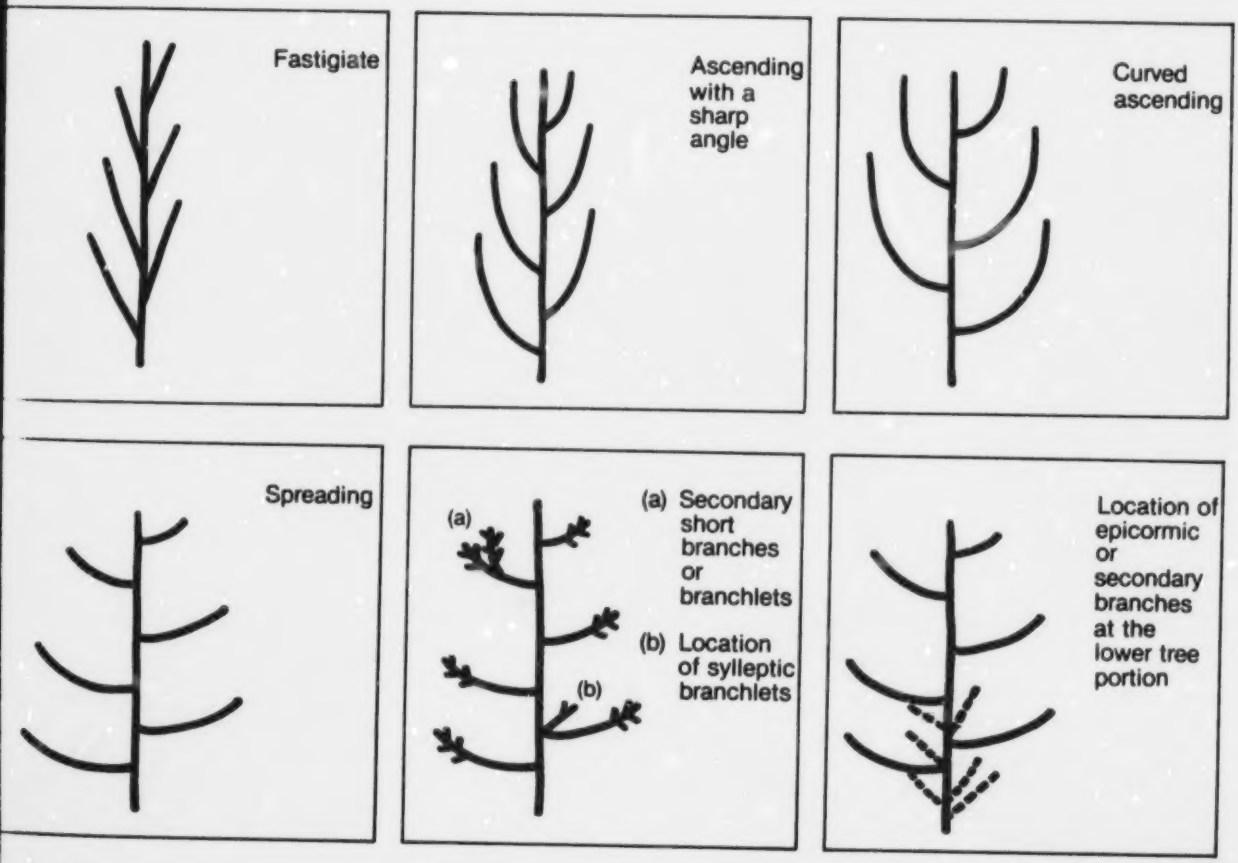
5
DN 10
DN 74
I-45/51
Jackii 4



6
DN 5
DN 9
DN 14
DN 15
DN 28

Branches

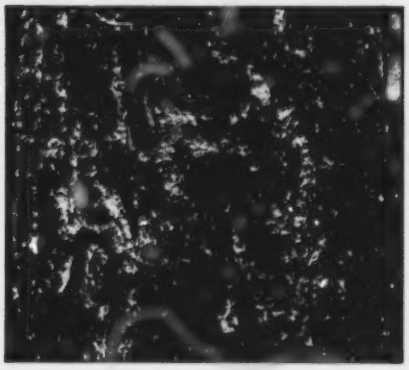
The branching habits of poplar clones fall loosely into six distinct types. For the purposes of this guide there was a tendency to take pictures of the various clones at similar planting sites or at least under approximately similar conditions and in closely related age classes. Plantations in Brockville, Pembroke, Kemptville, and Greenbelt around Ottawa appeared to be appropriate ones, and as a result most of the tree photographs in these pages were taken there.



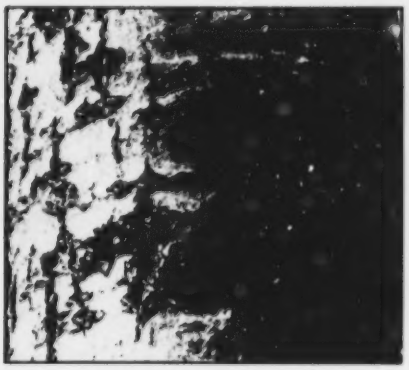
Bark

When examining the trunk, always examine the whole trunk to get an overall impression of the typical bark; in addition, look for bark details at eye level. The mature bark of the lower trunk is different from the bark of the upper section. The bark samples that have been selected for each clone represent average mature barks approximately 15 to 20 years of age. The size of scales or furrows tend to become exaggerated with age, so make allowances for this when looking at very old trees. Six types of old bark can be distinguished:

Type 1
Broad, flat-topped, deeply fissured with longitudinal ridges. Examples are DN 5, DN 19, DN 34.
When incompletely healed pruning wounds appear on the bark surface, the clone is probably DN 25.



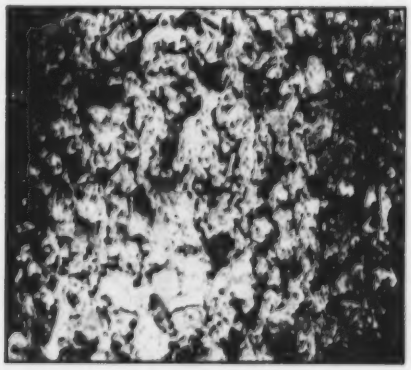
Type 2
Deeply furrowed and sharply broken transversely into oblong or rectangular blocks.
Examples are DN 16, DN 22, DN 33.
When incompletely healed pruning wounds appear on the bark surface, the clone is most likely DN 15.



Type 3
Roughened by bands of wart-like growths and divided into flat ridges.
Examples are DN 28, DN 30, DN 31, DN 38.

Type 4
Scaly plates and shallow vertical fissures with dark triangular-shaped blotches and warts.
Examples are DN 36 and Jackii 34.
When the whitish creamy-smooth bark is scaly but not fissured, the clone will be DTAC-2.

Type 5
Whitish grey and smooth, with horizontal lenticels; blotched scars mark the fraying bark.
Examples are DN 14, DN 17, DN 21, DTAC-1.



Type 6
Light grey, shallowly fissured; closely pressed with irregular scales. DN 18 is an example.

Distinct Features

1

There are many distinct features that distinguish one variety of poplar from another. Here are a few examples of such anomalies.

A deformed leaf shape (Figure 1) develops during defoliation time, especially on DN 18.

Whorls (Figure 2) develop on DN 21 at an advanced age. They occur at about one to two metres above ground level.

Jackii 34 leaves (Figure 3) grow in clusters on short branches. The leaves are usually shiny green, but they are about the first leaves to turn yellow in the autumn, while the others are still a rusty green.

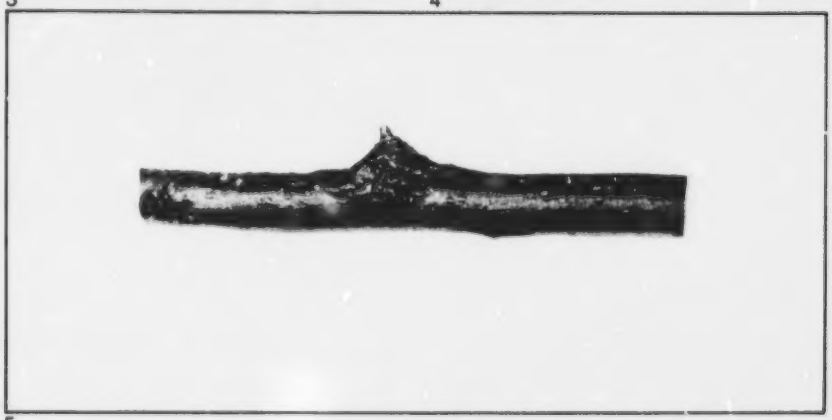
Sylleptic branchlets (Figure 4) were found in the autumn on DN 7, DN 19, DN 30, I-45/51, DTAC-2, and Jackii 4.

Sunscald (Figure 5) develops to canker on most of the Italian clones and on DN 74.

2

3

4



5

Ontario Code: DN 1

Populus x euramericana 'Allenstein'

Diagnostic Features:

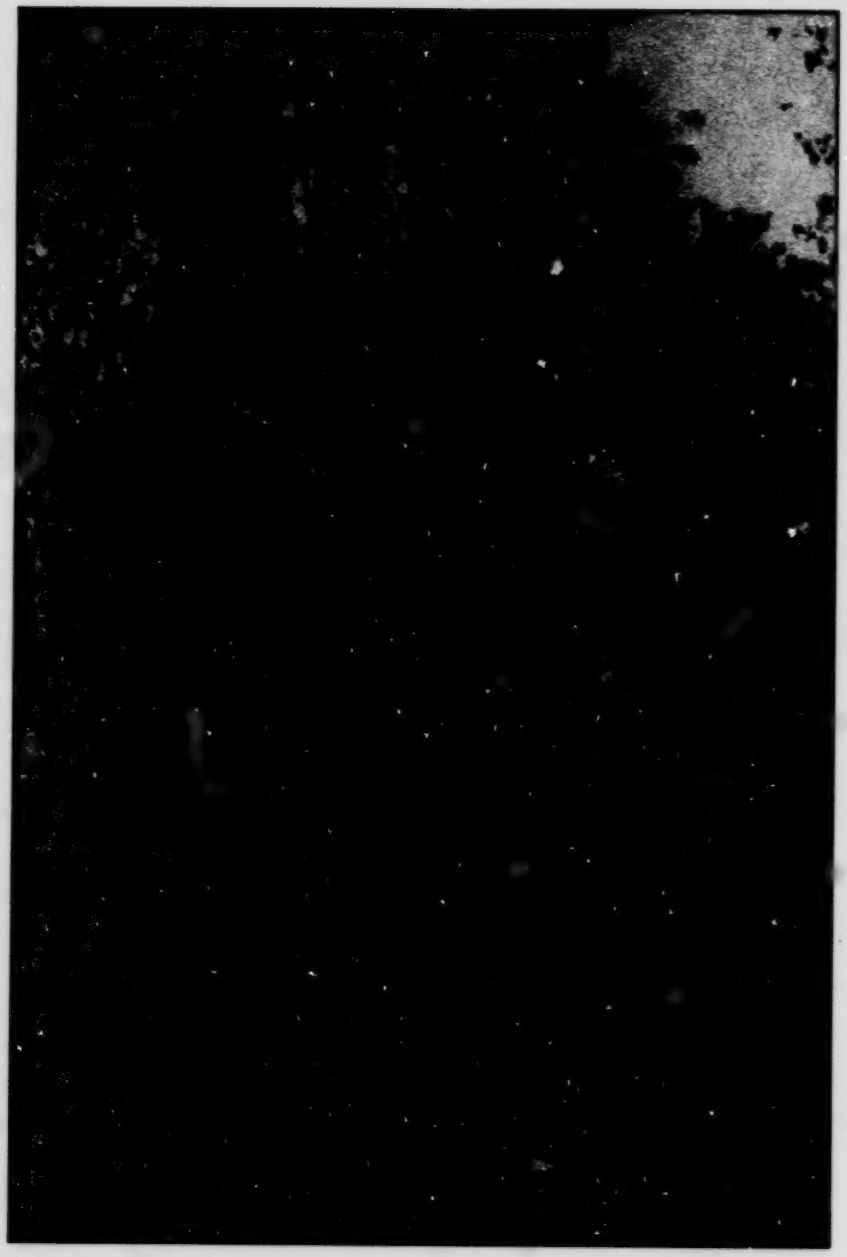
Leaf Deltoid and as long as it is wide, with a pointed tip. Broadly cuneate or straight base, occasionally notched. Margin moderately serrate, with a feeble undulate and glands present. Pale red midrib at an approximately 60° angle. Red petiole is half as long as leaf.

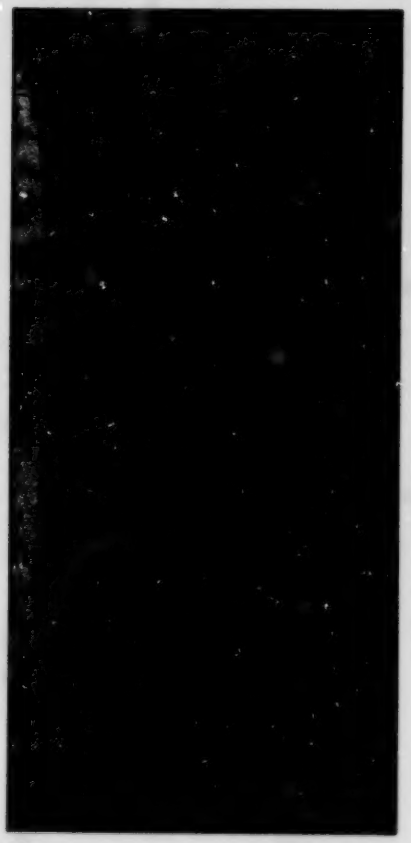
Bud Gummy and twice as long as it is wide at the base. In shape, oval and acuminate. Position to stem is appressed, concave, and leaning sideways. Shape of leaf scar: class 2.

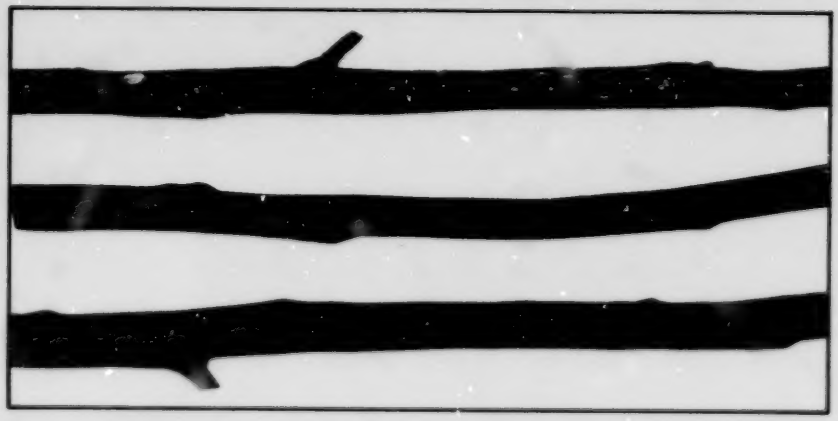
Twig In cross-section, feeble angular with ribs. Upper section light brown and mottled; lower section greenish grey. Lenticels are small, densely dispersed, and occasionally spotted below the leaf scar. Position to stem is curved ascending with fastigiate outlook; dense secondary branches at the lower section of the stem at a 40° angle.

Phenology Initial leaf colour: purplish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note In a close stand, epicormic branches disappear and long shoots develop in the upper section of the stem.







Ontario Code: DN 2

Populus x euramericana 'Baden 431'

Diagnostic Features:

Leaf	Deltoid and somewhat longer than it is wide, with an acuminate tip. Straight base, sometimes dent, with feeble notched; glands present. Margin moderately serrate, with a short undulate. Pale red midrib at a 60° to 65° angle. Petiole is red in summer and two-thirds of the blade length.
Bud	Twice as long as wide at the base. In shape, slender and humpy at the base. Position to stem is appressed. Shape of leaf scar: class 4.
Twig	In cross-section, feeble angular with ribs. Upper section light brown; lower section greenish grey. Lenticels are oval and spotted below the leaf scar. Position to stem is broad ascending; dense secondary branches at a 50° angle.
Phenology	Initial leaf colour: brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Ontario Code: DN 5

Populus x euramericana 'Gelrica'

Diagnostic Features:

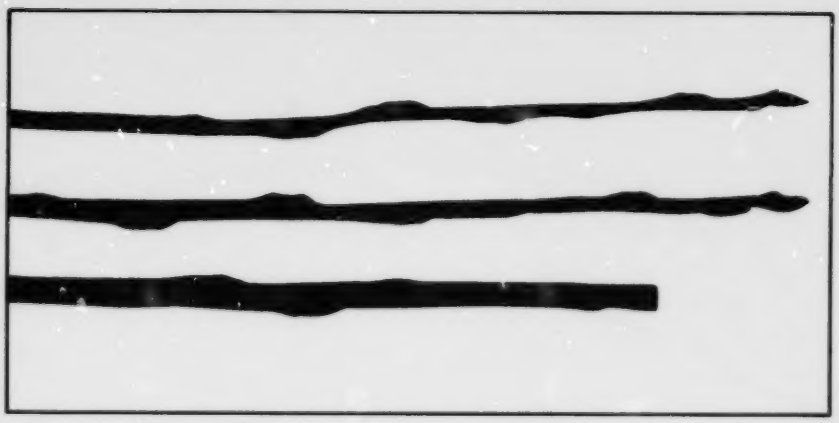
Leaf Deltoid (tri-angle) and as long as it is wide. Tip is from acuminate to acute. The base is straight or dent, with feeble notched; glands present. Margin moderately serrate and widely undulate. Pale red or whitish green midrib is at a 65° angle. Pale red petiole, which turns to red in summer, is half as long as the blade.

Bud In size, small and three times as long as it is wide. Distinct dark brown colour, gummy. In shape, ovate, pointed, or acuminate. Position to stem is appressed, tip out-curved. Shape of leaf scar: class 6.

Twig In cross-section, terete with feeble ribs. Upper section yellowish brown; lower section greenish grey or dark grey. Lenticels are usually inconspicuous on terminal shoot and spotted below scars. Position to stem is spreading; short secondary branches dense in the upper section of the stem at a 40° to 50° angle.

Phenology Initial leaf colour: purplish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note Mature bark above eye level is distinctly whitish with dark blotches.

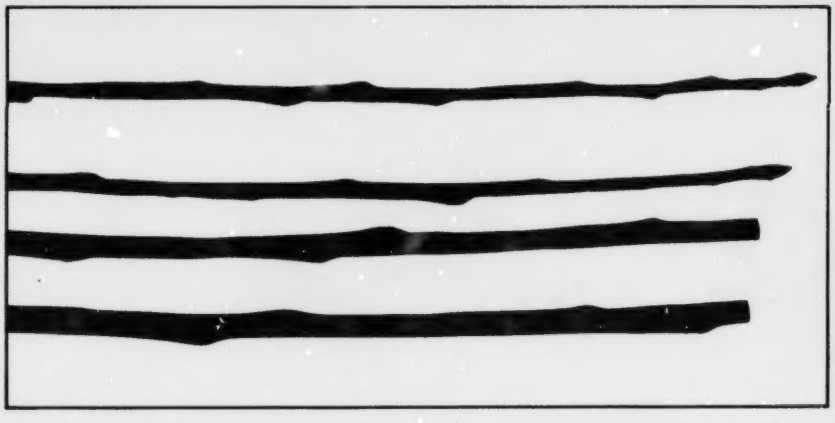


Ontario Code: DN 7

Populus deltoides var. Missouriensis 'Heidemij'

Diagnostic Features:

Leaf	Deltoid and as long as it is wide, with a pointed tip. Straight to round base, feeble notched on broadly straight base. Gland occasionally present. Margin serrate, with a feeble undulate. Red midrib at a 60° angle. Red petiole is half as long as the blade.
Bud	Three times as long as it is wide. Acute, oval, and lightly gummy. Position to stem is ascending. Shape of leaf scar: class 2.
Twig	In cross-section, angular with sharp ribs. Upper section yellowish green in August, reddish brown and mottled before August; lower section dark brown. Lenticels are oblong, dense, and spotted below the leaf scars. Position to stem is curved ascending; short secondary branches growing in the upper portion of the crown at a 40° angle.
Phenology	Initial leaf colour: purplish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.
Note	Sylleptic branchlets develop during the summer.



Ontario Code: DN 9

Populus x euramericana 'Löns'

Diagnostic Features:

Leaf

Rhomboid and as long as it is wide, with a pointed to acuminate tip. The base is straight or broadly cuneate, with glands present. The margin is coarsely serrate and slightly undulate. Pale red midrib is at an 80° angle. Pale red petiole is half as long as the blade.

Bud

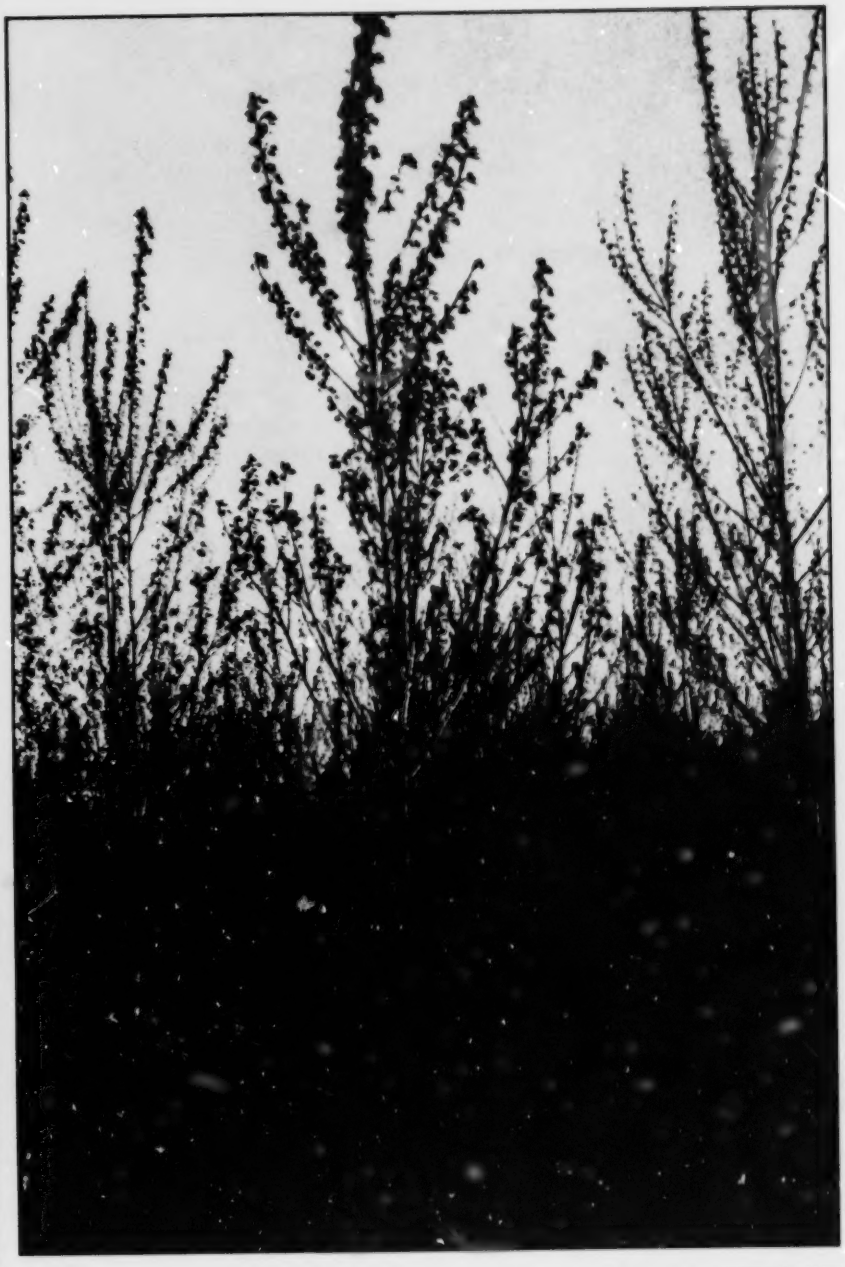
Very gummy and one and a half times as long as it is wide. In shape, plump, humpy at base, with the tip hooking inwards. Position to stem is appressed. Shape of leaf scar: class 6.

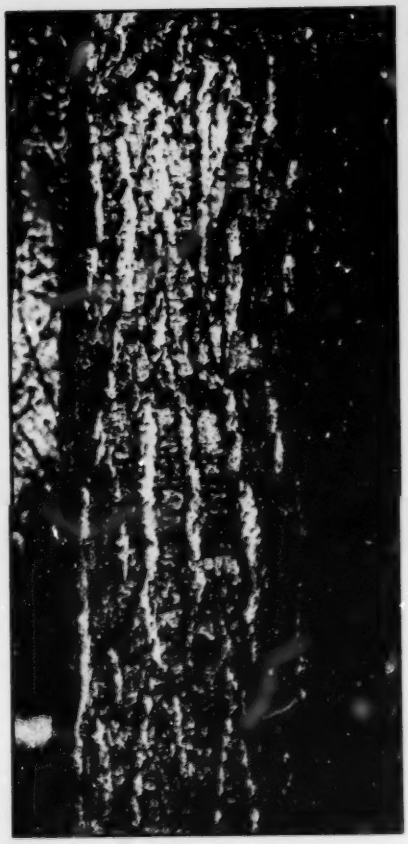
Twig

In cross-section, angular with ribs. Upper section mottled and brown; lower section greenish grey. Lenticles are oblong, small, and dispersed with spotting below scars. Position to stem is curved ascending; lacking secondary branches.

Phenology

Initial leaf colour: greenish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.





Ontario Code: DN 10

Populus x euramericana 'Robusta'

Diagnostic Features:

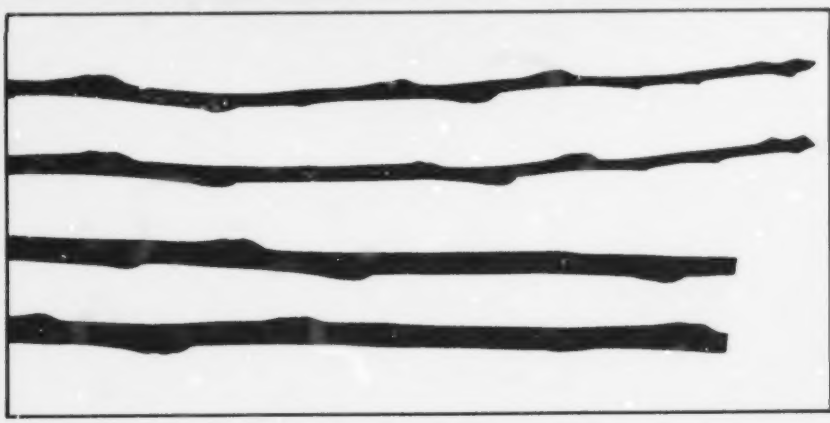
Leaf Deltoid and as long as it is wide, with a pointed tip. Straight, notched base, with glands present. Margin coarsely serrate but not toothed and with a strong undulate. Pale red midrib is at a 50° angle. Red petiole is half as long as the blade.

Bud Gummy in traces and twice as long as it is wide. In shape, oblong, acute, and slender. Position to stem is ascending. Shape of leaf scar: class 5.

Twig In cross-section, terete or slightly angular and rarely ribbed. Upper section mottled and light brown; lower section dark greenish grey. Lenticels are oval and widely dispersed. Postion to stem of leaders is sharply ascending; short secondary branches grow along the stem.

Phenology Initial leaf colour: light reddish purple. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note Bark damages are very common.



Ontario Code: DN 14

Populus x euramericana 'Harff'

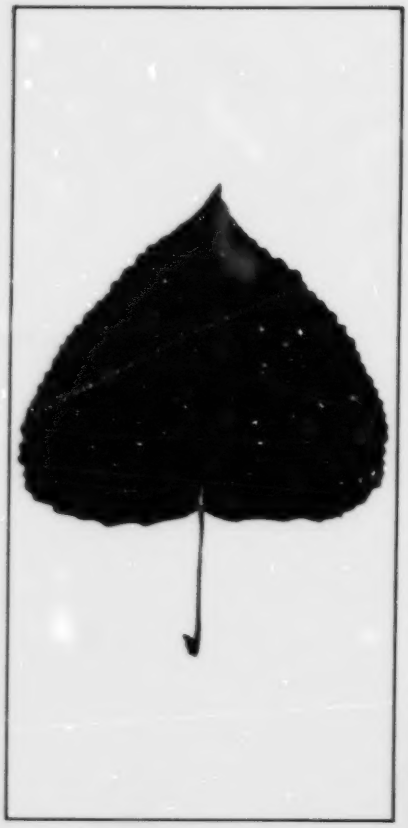
Diagnostic Features:

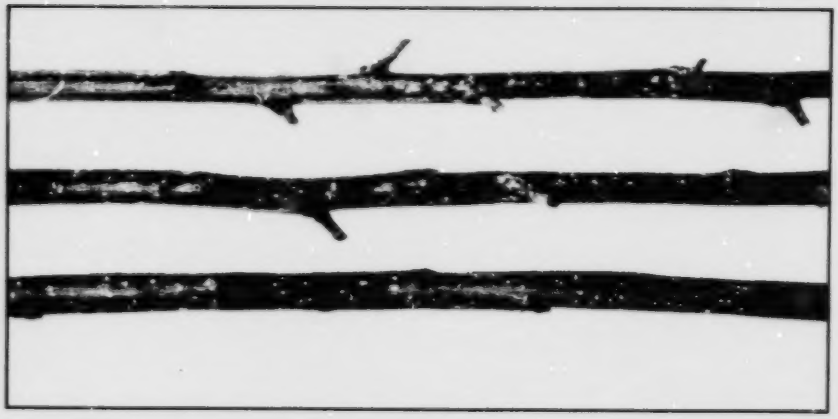
Leaf Deltoid and somewhat longer than it is wide, with an elongated, acuminate tip. Straight to dent base, with glands present. Margin serrate, feeble notched, with an undulate. White midrib is at an approximately 90° angle. Distinctly red petiole is half of the blade length.

Bud Shiny and gummy and twice as long as it is wide. In shape, pointed and slender or oval. Position to stem is ascending. Shape of leaf scar: class 6.

Twig In cross-section, angular with ribs. Upper section brown, pale and mottled; lower section greyish green. Lenticels are oblong and dispersed, with spotting below scars. Position to stem is slightly curved ascending; some secondary branches grow in whorl in the upper portion of the stem.

Phenology Initial leaf colour: dark brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.





Ontario Code: DN 15

Populus x euramericana 'Regenerata Aube'

Diagnostic Features:

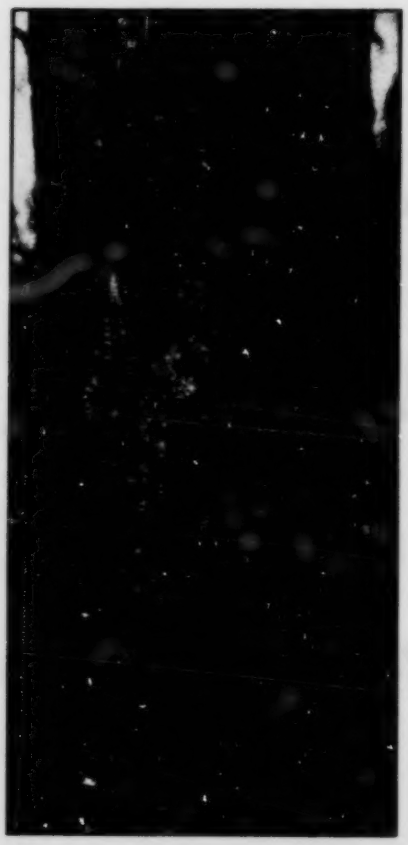
Leaf Deltoid and as long as it is wide, with a pointed (sometimes blunt) tip. Broadly straight, notched base, with glands present. Serrate margin. White midrib is at a 70° to 75° angle. Red petiole is less than half the length of the blade.

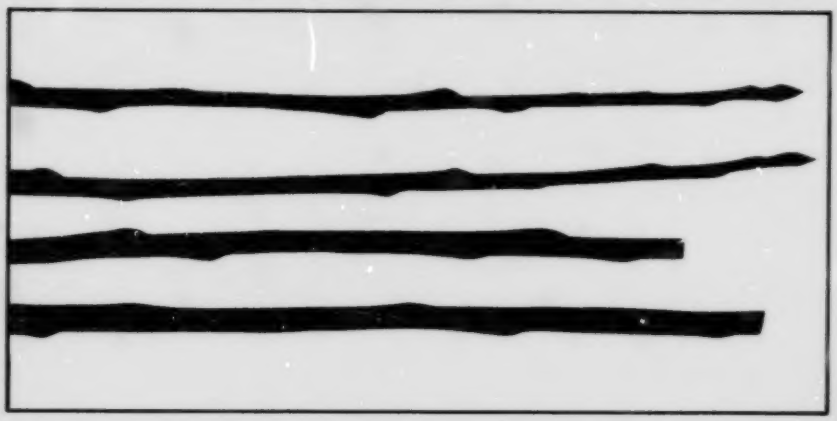
Bud Gummy and approximately three times as long as it is wide. In shape, ovate, humpy at the base, pointed and leaning sideways. Position to stem is ascending. Shape of leaf scar: class 6.

Twig In cross-section, terete. Upper section light brown to greyish brown; lower section dark green tinged grey. Lenticels are large, oval, widely dispersed, and spotted below leaf scars. Position to stem is spreading impression ascending; short secondary branches form a dense crown at a 40° angle.

Phenology Initial leaf colour: green with a brown tinge. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note Only very poorly growing trees were found in this survey; the twigs were not properly lignified. Leaf irregularity concerning the margin line is quite common in late summer.





Ontario Code: DN 16

Populus x euramericana 'Regenerata Bâtard d'Hautervive'

Diagnostic Features:

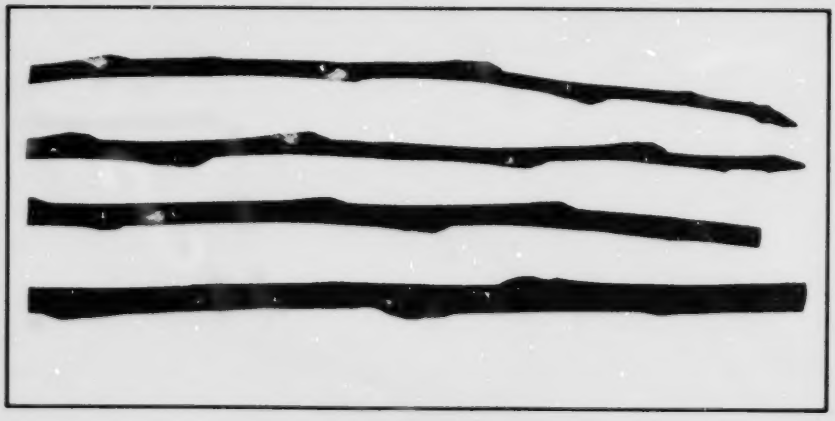
Leaf Rhombo-deltoid and somewhat longer than it is wide, with an acuminate tip. Straight, feeble notched base, with glands present. Margin serrate and strongly undulate. White midrib is at an 80° angle. Red petiole is half as long as the blade.

Bud Extremely gummy and three times as long as it is wide at the base. In shape, plump, pointed and humpy at the base. Position to stem is appressed, concave and a leaning tip. Shape of leaf scar: class 4.

Twig In cross-section, angular with ribs. Upper section dark brown; lower section greenish grey. Lenticels are oval, widely dispersed and occasionally spotted below scars. Position to stem is erect branching; short secondary branches grow densely in the lower portion of the tree at a 50° angle.

Phenology Initial leaf colour: green with a brown tinge. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note The sharp angle of the ascending leaders is conspicuous.



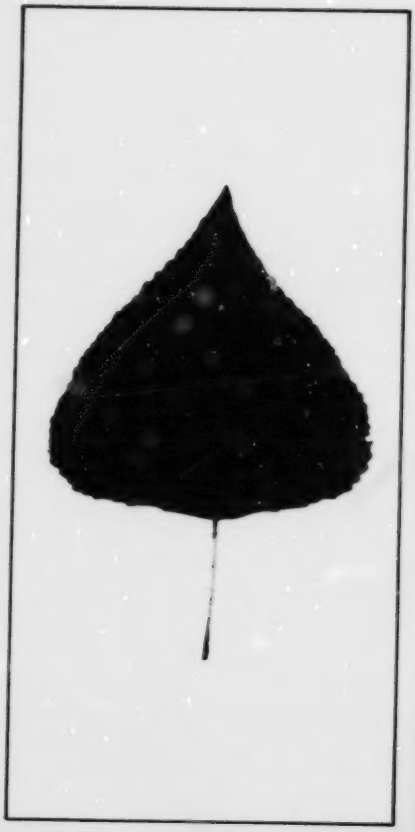
Ontario Code: DN 17

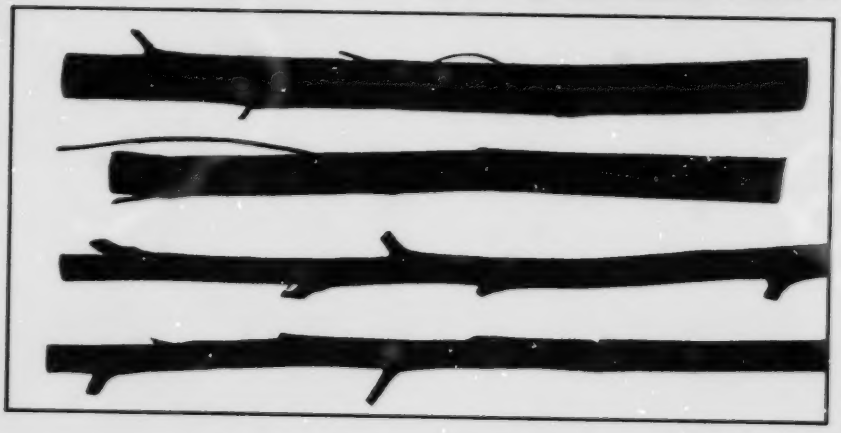
Populus x euramericana 'Robusta'

Diagnostic Features:

Leaf	Deltoid and as long as it is wide, with an acuminate to pointed tip. Slightly dent or rounded, feeble notched base, with glands present. Finely serrate and moderately undulate margin. White or pale red midrib is at a 70° angle. Red petiole is two-thirds as long as the blade.
Bud	Slightly gummy and two and a half times as long as it is wide. In shape, oblong and acuminate. Position to stem is appressed. Shape of leaf scar: class 4.
Twig	In cross-section, moderately angular and rather terete at the tip. Upper section reddish light brown; lower section grey to green. The lenticels are small, oval, and regularly dispersed. Position to stem is ascending; dense secondary branches grow at a 40° angle.
Phenology	Initial leaf colour: purplish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note Bark damages are often seen on this clone.





Ontario Code: DN 18

Populus x euramericana 'Tardif de Champagne' or 'Raverdeau'

Diagnostic Features:

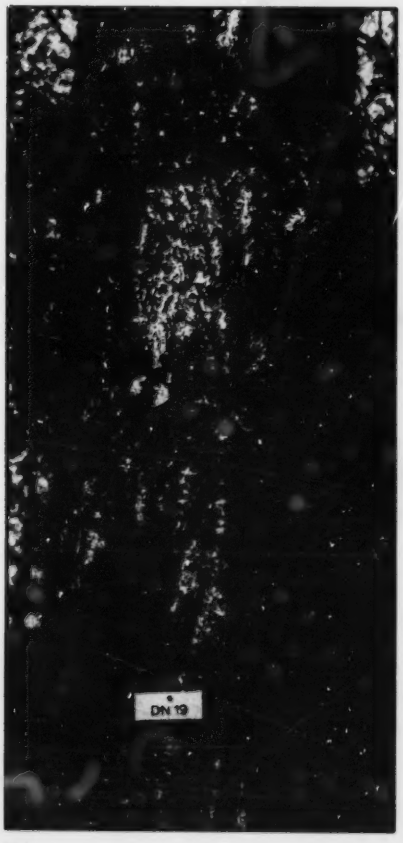
Leaf Deltoid or rhombo-deltoid and somewhat longer than it is wide, with an acute or sharp pointed tip. Broadly dent, unnotched base, with glands present. Coarsely serrate margin with sharp hooks and a feeble undulate. Very red midrib is at a 60° angle. The petiole is usually very red and half the length of the blade.

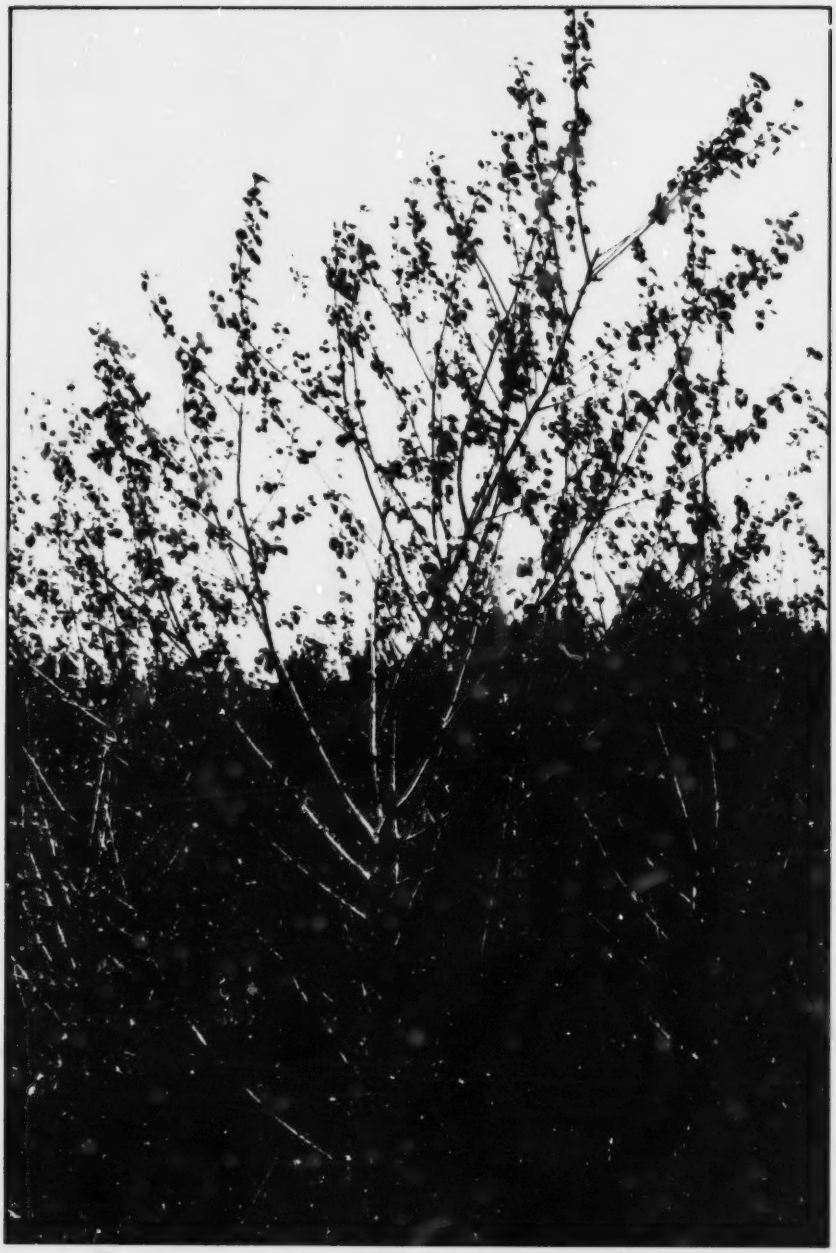
Bud Gummy and three times longer than it is wide. In shape, plump to ovate and pointed. Position to stem is ascending and leaning sideways. Shape of leaf scar: class 2.

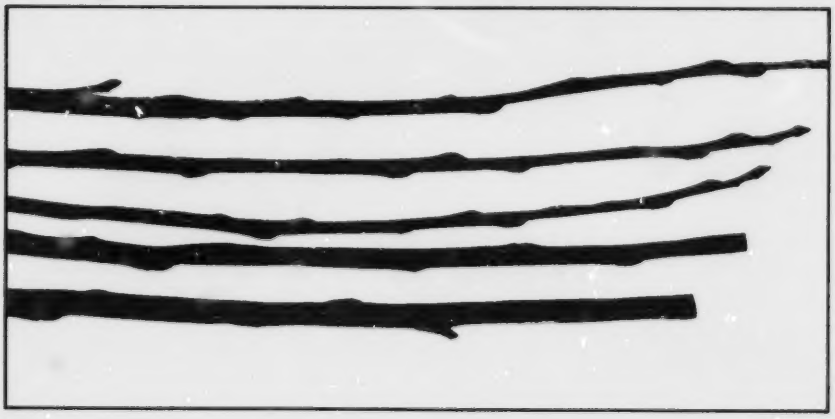
Twig In cross-section, terete, rarely with ribs. Upper section reddish brown; lower section greyish. The lenticels are oval, small, widely dispersed, and spotted below the scars. Position to stem is curved ascending; short ascending branches are found in the upper portion of the tree and provide a bushy crown at a 70° angle.

Phenology Initial leaf colour: yellowish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note This clone has a characteristically deformed leaf shape that develops during defoliation.


DN 19





Ontario Code: DN 19

Populus x euramericana 'Blanc du Poitou'

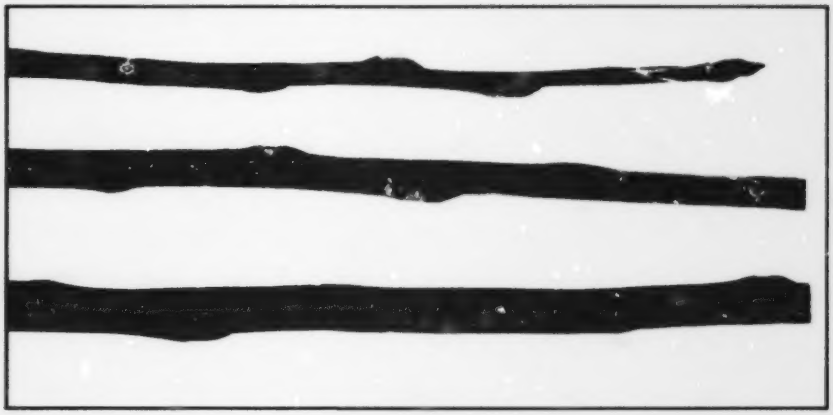
Diagnostic Features:

Leaf Deltoid and as long as it is wide, with a pointed tip. Broadly cuneate and feeble notched base. Finely serrate margin with a moderate undulate. White or pale red midrib is at a 75° angle. Red petiole is somewhat shorter than the length of the blade.

Bud Twice as long as it is wide. In shape, plump, acute, humpy at the base, and leaning sideways. Position to stem is appressed. Shape of leaf scar: class 3.

Twig In cross-section, angular with ribs. Upper section dark brown; lower section greenish grey and mottled yellow. The lenticels are enlarged along the length and widely dispersed. Position to stem of long shoots is spreading and erecting; sylleptic branchlets appear at the top.

Phenology Initial leaf colour: very light brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.



Ontario Code: DN 21

Populus x euramericana 'Jacometti' or 'I-78-B'

Diagnostic Features:

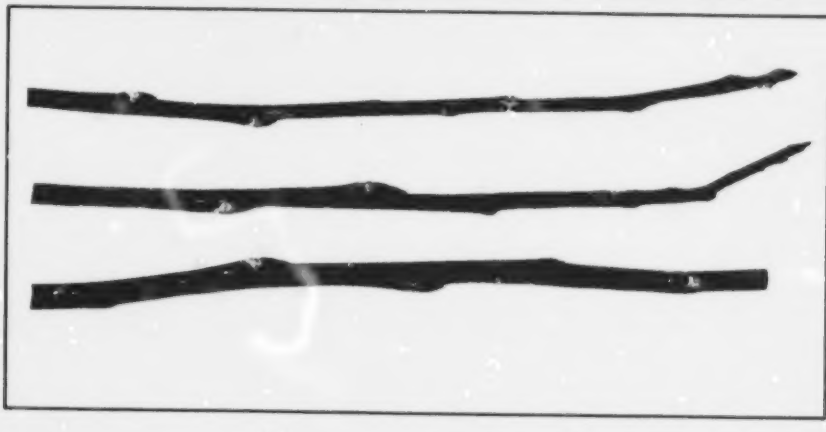
Leaf Deltoid and somewhat wider than it is long, with an acuminate or sharp and pointed tip. The cordate base is sharply notched. Finely serrate, strongly undulate margin has glands present. Pale red midrib is at a 75° to 80° angle. Pale red petiole is half as long as the blade and very flat.

Bud Gummy and twice as long as it is wide at the base. In shape, oblong and acuminate. Position to stem is appressed. Shape of leaf scar: class 2.

Twig In cross-section, angular and occasionally found with ribs. Upper section light reddish brown and mottled; lower section dark brown. The lenticels are very small, dispersed and circular in shape. Position to stem is ascending at a sharp angle; secondary branches appear at a 50° angle.

Phenology Initial leaf colour: yellowish or reddish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note In advanced age, whorls develop on this clone at about one to two meters above ground.



Ontario Code: DN 22

Populus x euramericana 'I-262'

Diagnostic Features:

Leaf

Rhomboid to rhomboid-deltoid and as long as it is wide, with an acuminate tip. Straight to broadly cuneate base. Serrate margin with a feeble undulate. Red midrib is at a 75° to 80° angle. Red petiole is somewhat longer than half the blade length.

Bud

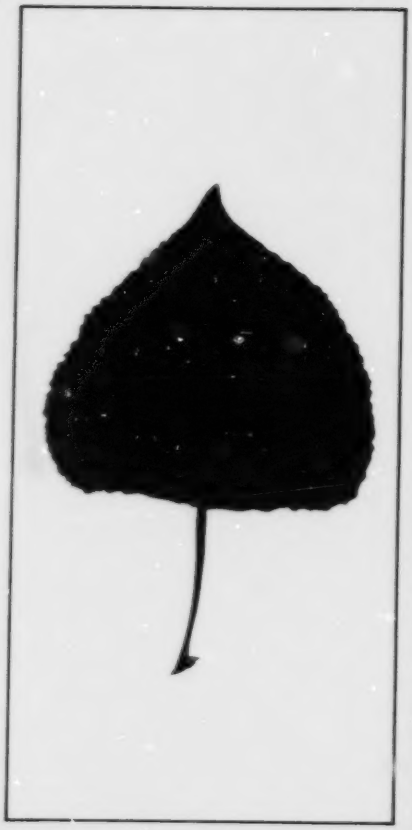
Small and twice as long as it is wide. In shape, slender and pointed. Position to stem is ascending. Shape of leaf scar: class 1.

Twig

In cross-section, terete with feeble ribs. Sometimes the leaders are feeble angular. Upper section reddish dark brown and mottled; lower section grey. The lenticels are small, oblong, and dispersed, with spotting below the leaf scars. Position to stem is straightly ascending; no secondary branches.

Phenology

Initial leaf colour: dark purplish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.



Ontario Code: DN 25

Populus x euramericana 'I-55/56'

Diagnostic Features:

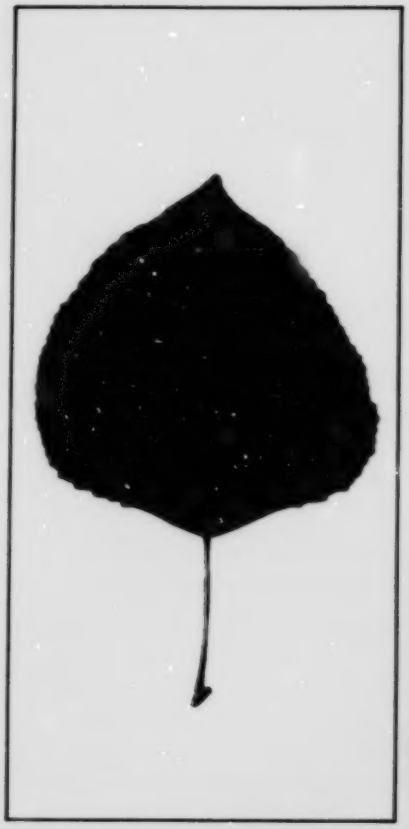
Leaf Deltoid and as long as it is wide, with a pointed tip. Straight to dent, unnotched base has glands present. Coarsely serrate and moderately undulate margin. Very red midrib is at an 80° angle. Very red petiole is half as long as the blade.

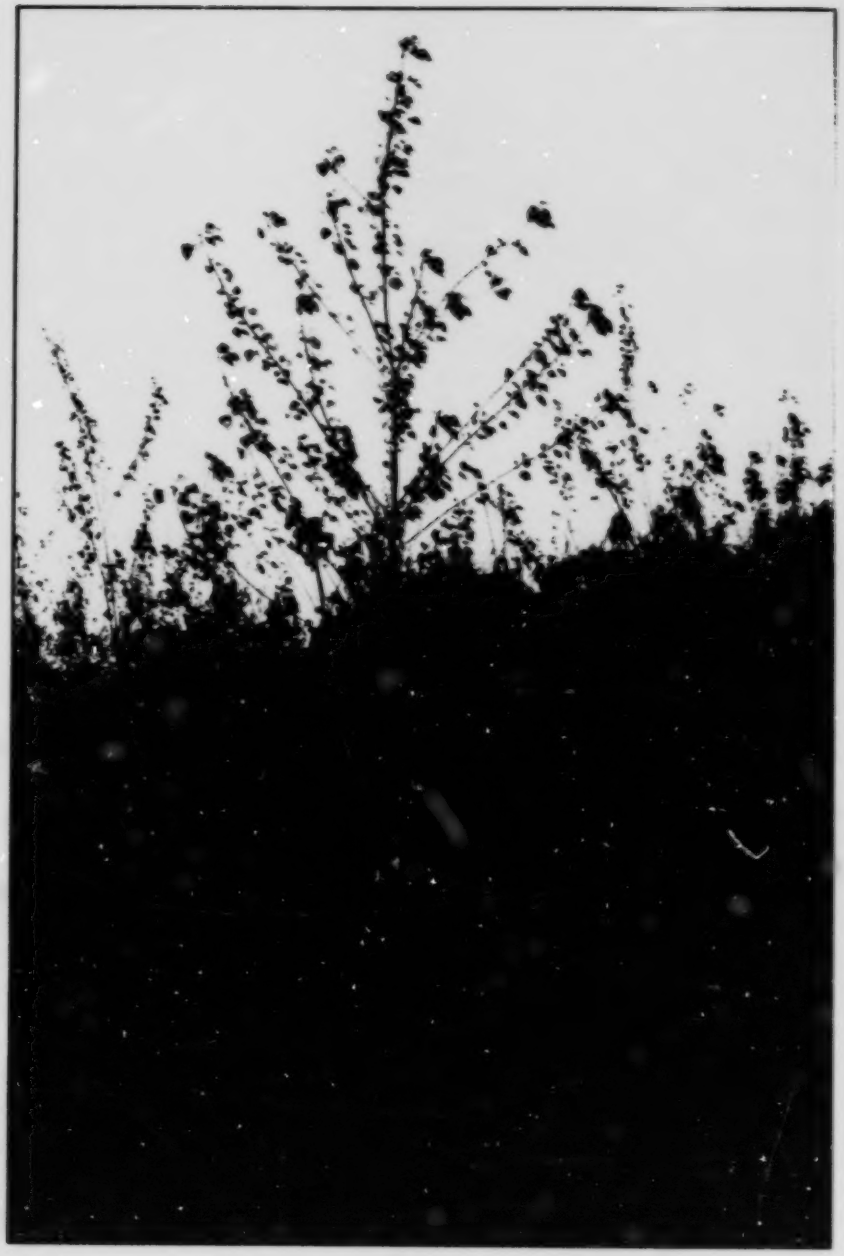
Bud Small and longer than it is wide by a margin of one and a quarter. In shape, plump, pointed, and with a humpy base. Position to stem is ascending. Shape of leaf scar: class 4.

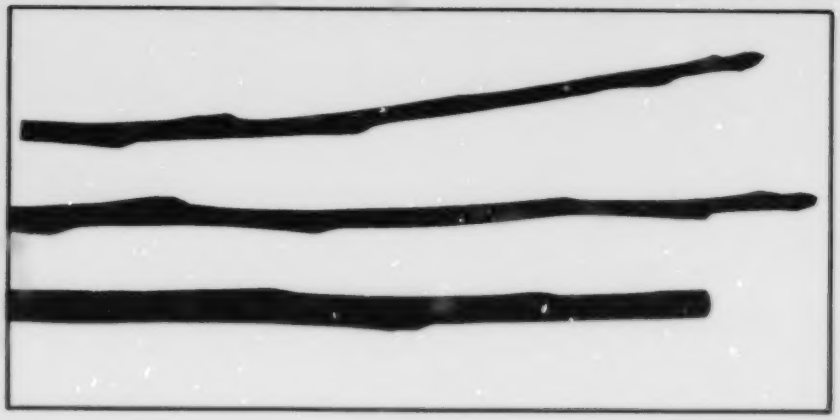
Twig In cross-section, angular with ribs; the leaders are often twisted. Upper section reddish to purplish brown; lower section greyish brown. The lenticels are circular, well dispersed, and sometimes inconspicuous. Position to stem is straight ascending; secondary branches occur at a 65° angle.

Phenology Initial leaf colour: dark brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note Sunscald, cankers, and other bark defects are common in this clone.







Ontario Code: DN 28

Populus x euramericana 'Ostia' or 'Pinseque'

Diagnostic Features:

Leaf

Rhomboid or rhombo-deltoid and somewhat longer than it is wide, with a pointed tip. Unnotched, cuneate to straight base has glands present. Serrate and moderately undulate margin. Red midrib is at a 75° angle. Red petiole is usually shorter than half of the blade length.

Bud

Gummy and twice as long as it is wide. In shape, slender and pointed. Position to stem is ascending, leaning out, and convex. Shape of leaf scar: class 6.

Twig

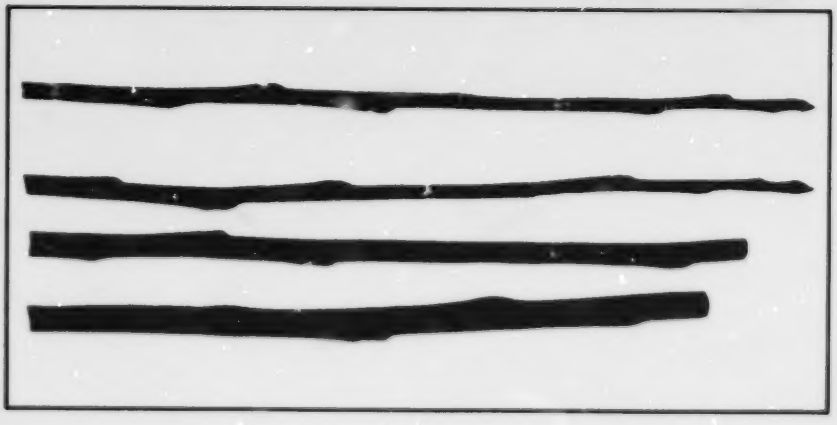
In cross-section, angular with feeble ribs. Upper section reddish brown; lower section dark green with light brown ribs. Lenticels are small, slightly visible, oval, and widely dispersed. Position to the stem is spreading and erect; secondary branches are found in the lower portion of the stem at a 45° angle.

Phenology

Initial leaf colour: very dark purple or brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note

The extremely dark colour of flushing leaves is distinct in this clone.



Ontario Code: DN 30

Populus x euramericana 'Canada Blanc'

Diagnostic Features:

Leaf

Rhombo-deltoid and as long as it is wide, with an acuminate tip. Usually broadly cuneate base. Serrate margin with large teeth; wavy but with no undulate. Pale red midrib is at a 75° angle. Red petiole is half the length of the blade.

Bud

Very gummy and twice as long as it is wide. In shape, plump and pointed; it becomes slender at the tip of the leaders. Position to stem is ascending. Shape of leaf scar: class 1 and very small.

Twig

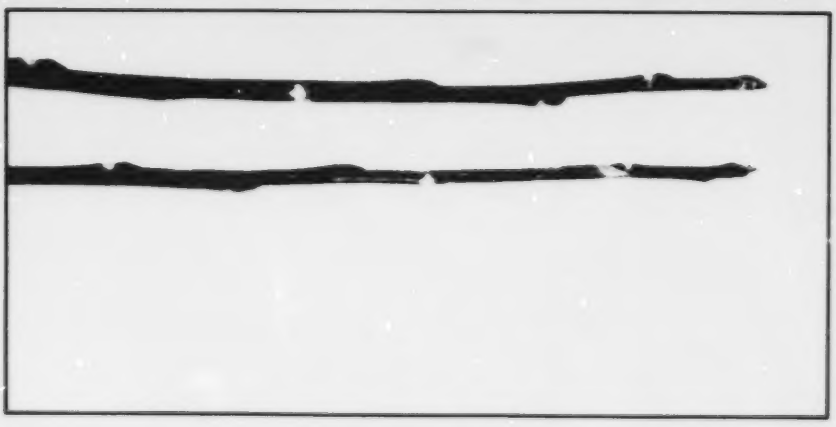
In cross-section, angular with ribs. Upper section purple to dark brown and pale mottled; lower section greyish brown. The lenticels are circular, widely dispersed, and occasionally spotted below the scars. Position to stem is curved ascending or spreading; secondary branches are common and occasionally sylleptic branchlets develop.

Phenology

Initial leaf colour: dark purple with a green petiole. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note

The brown bark on the leaders and the red petiole are quite distinct in DN 30.



Ontario Code: DN 31

Populus x euramericana 'Negrito de Granada'

Diagnostic Features:

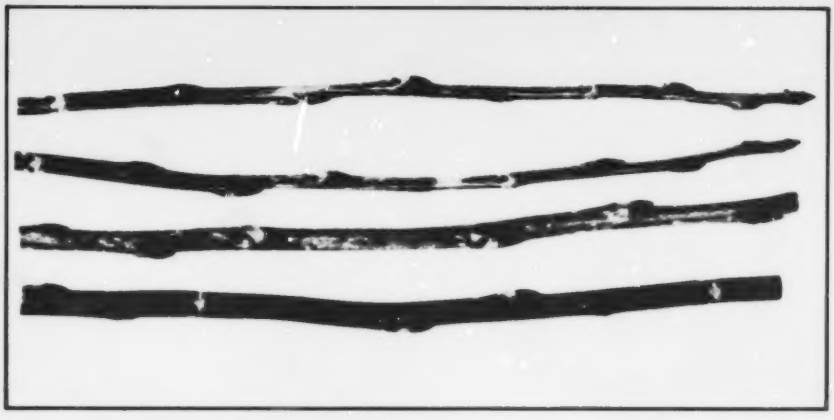
Leaf Deltoid and as long as it is wide, with a pointed tip. Broadly cuneate base. Finely serrate margin, with a moderate undulate. Pale red midrib is at a 70° angle. Very red petiole is half as long as the blade.

Bud Gummy and twice as long as it is wide. In shape, oblong, leaning sideways and acuminate. Position to stem is ascending. Shape of leaf scar: class 4.

Twig In cross-section, angular with fine ribs. Upper section, purplish brown; lower section green. The lenticels are oblong, dispersed, and occasionally spotted below scars. Position to stem is curved ascending.

Phenology Initial leaf colour: brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note In this study, only trees that had performed poorly were found.



Ontario Code: DN 33

Populus deltoides var. Virginie 'Nancy'

Diagnostic Features:

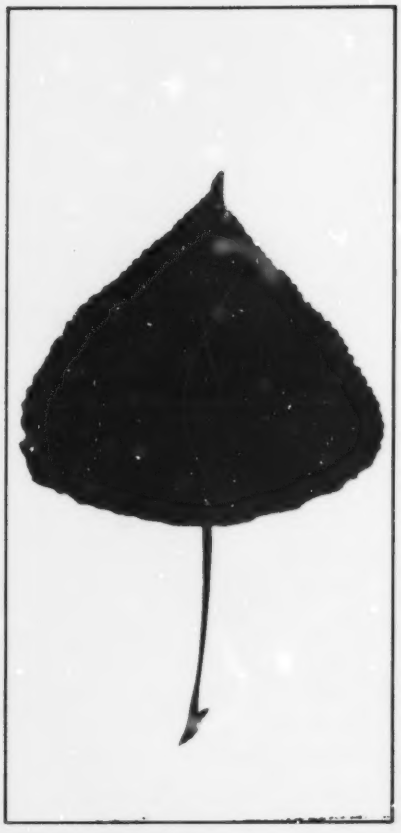
Leaf Deltoid to delto-rhomboid and as long as it is wide, with an acuminate tip. Broadly cuneate unnotched base. Coarsely serrate margin with a strong undulate. Pale red midrib is at an 80° angle. Pale red petiole is half as long as the blade.

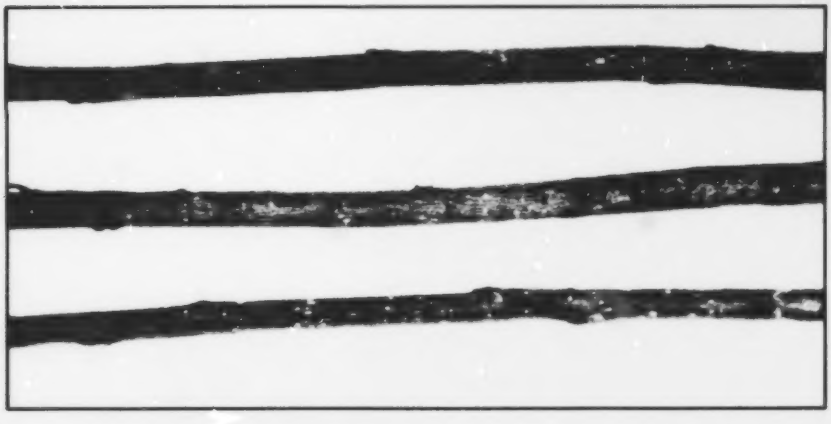
Bud In size, two and a half times as long as it is wide. In shape, plump, with a short tip and a wide base. Position to stem is ascending, leaning sideways. Shape of leaf scar: class 2 and quite large.

Twig In cross-section, feeble angular with fine ribs. Upper section greenish or light brown; lower section greyish brown. The lenticels are oblong, denseiy dispersed, and have spotting below the scars. Position to stem is broadly ascending; abundant secondary branches appear at the crown.

Phenology Initial leaf colour: purplish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note Numerous swellings on bark were found, showing poor performance on the part of this clone.





Ontario Code: DN 34

Populus deltoids Bartr. Syn. *Populus angulata* Ait. 'Carolina'

(The common name for DN 34 is the 'Carolina' poplar. [F. L. Little, Sr., 1953.] Originated in many places in the United States, it has escaped locally. The name 'Carolina poplar' was accepted in the 1927 checklist and it has not been changed since.)

Diagnostic Features:

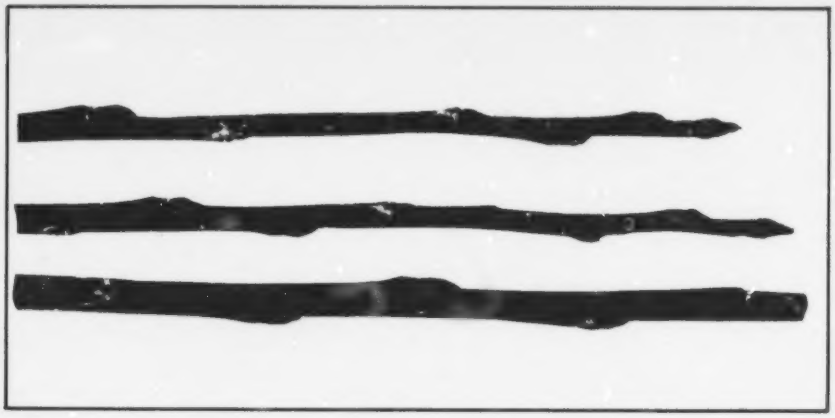
Leaf Deltoid and as long as it is wide, with an acuminate tip. Broadly cuneate, unnotched base, with glands present. Roughly serrate margin has a strong undulate. Pale red midrib is at a 60° angle. Pale red petiole is somewhat longer than half the length of the blade.

Bud Not gummy and two and a half times as long as it is wide. In shape, oval, pointed, and having a humpy base. Position to stem is appressed and leaning sideways. Shape of leaf scar: class 4.

Twig In cross-section, feeble angular with ribs. Upper section light brown; lower section green with light brown ribs. The lenticels are oblong with spotting below the leaf scars. Position to stem is ascending; upswept branches and forking leaders are common.

Phenology Initial leaf colour: unspecified. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note This clone featured the standard in phenological observations; flushing, terminal bud formation, and defoliation dates of the other 31 clones were related to those of this standard.



Ontario Code: DN 36

Populus angulata x Populus plantierensis Schrein. 'NE 35'

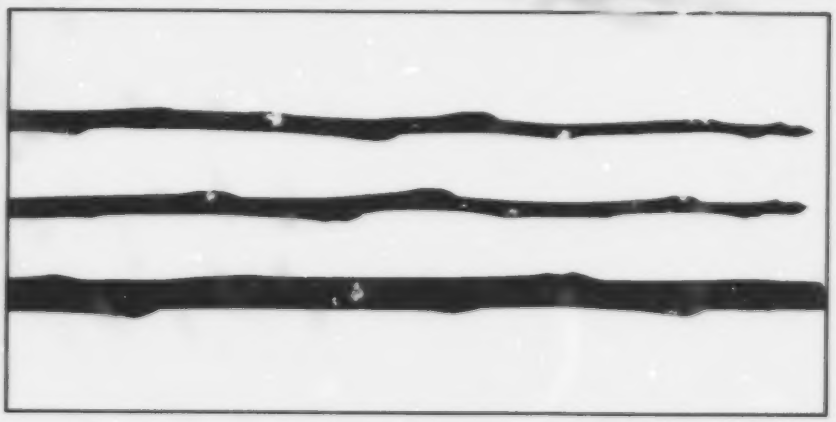
Diagnostic Features:

Leaf Deltoid (tri-angle) and somewhat longer than it is wide, with an acuminate tip. Straight and feeble notched base has glands present. Finely serrate and unhooked margin with a moderate undulate. Pale red midrib is at an 80° angle. Red petiole is half the length of the blade.

Bud Gummy and two and a half times as long as it is wide. In shape, ovate, pointed, and humpy at the base. Position to stem is appressed and concave. Shape of leaf scar: class 2.

Twig In cross-section, feeble angular with ribs. Upper section reddish brown; lower section greenish brown. The lenticels are circular and broadly dispersed. Position to stem is curved ascending; erect, dense, short secondary branches appear in the lower portion of the crown at a 40° angle.

Phenology Initial leaf colour: light brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.



Ontario Code: DN 38

Populus deltoides var. Virginiana x *Populus nigra* var. Schrein. 'NE 238'

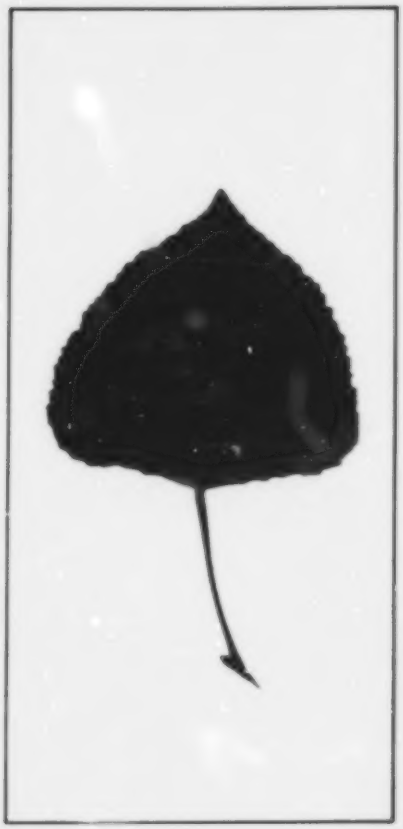
Diagnostic Features:

Leaf Tri-angled and somewhat longer than it is wide, with an acuminate tip. Broadly cuneate base. Finely serrate margin has a short-wave undulate. Pale red midrib is at a 70° angle. Pale red petiole is two-thirds as long as the blade.

Bud Gummy and large, it is three times as long as it is wide. In shape, it is slender and acuminate. Position to stem is ascending. Shape of leaf scar: class 2.

Twig In cross-section, feeble angular with ribs. Upper section, dark reddish brown; lower section dark green bark with distinct brown ribs. The lenticels are oblong and dispersed and show spotting below the scars. Position to stem is ascending at a sharp angle; secondary branches grow at a 40° angle.

Phenology Initial leaf colour: greenish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.



Ontario Code: DN 55

Populus deltoides x Populus nigra

(A local hybrid)

Diagnostic Features:

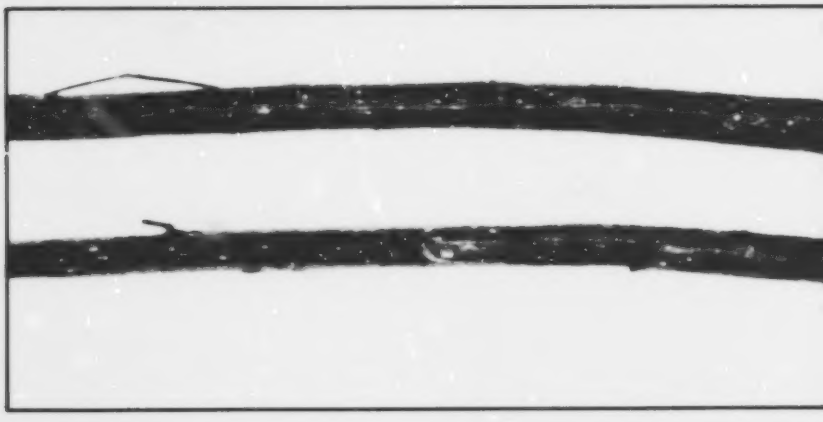
Leaf A dark green, distinct, tri-angle or deltoid shape wider than it is long, with a pointed tip. Straight to dent, unnotched base with glands present. Serrate (hooked) margin has a feeble undulate in wide waves. Very red midrib is at an 80° angle. Very red petiole extends approximately two-thirds the length of the blade.

Bud Very gummy and one and a half times as long as it is wide. In shape ovate, humpy at the base and pointed. Position to stem is ascending and concave. Shape of leaf scar: class 2.

Twig In cross-section, angular with feeble ribs. Upper section light brown; lower section greenish brown. The lenticels are circular and broadly dispersed, with spotting below the scars. Position to stem is ascending; twisted leaders are common in this species.

Phenology Initial leaf colour: brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note Swellings are quite common on lignified stems.



Ontario Code: DN 70

Populus deltoides x Populus nigra 'N3'

Diagnostic Features:

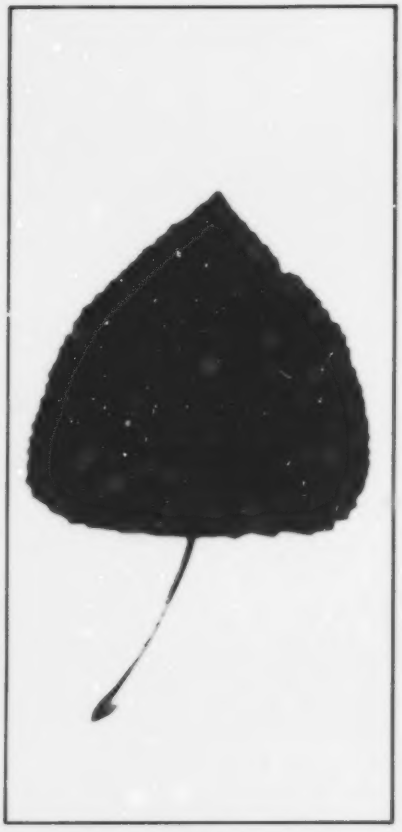
Leaf Deltoid, tri-angled, and as long as it is wide, with a pointed tip. Straight, feeble notched base. Finely serrate margin with no undulation. Dark red midrib is at a 70° angle. Dark red petiole is half the length of the blade.

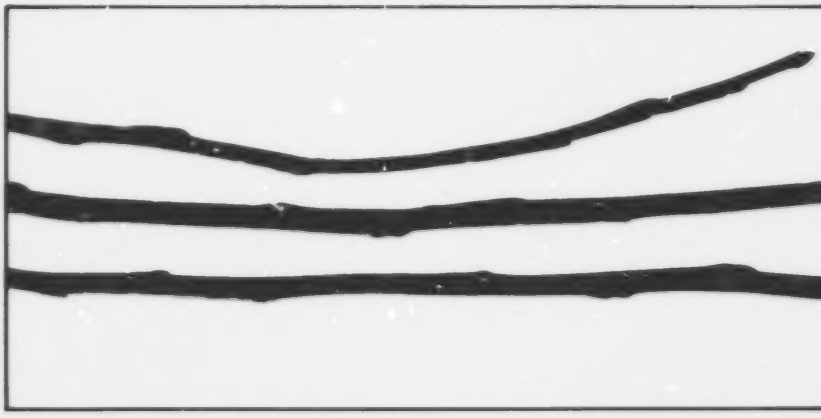
Bud Extremely gummy and twice as long as it is wide. In shape, ovate, pointed, and humpy at the base. Position to the stem is appressed with a concave tip. Shape of leaf scar: class 2.

Twig In cross-section, angular with ribs. Upper section dark red-brown; lower section also dark red-brown. The lenticels are small, oval, densely dispersed, and distinctly white on the dark reddish brown bark. Position to stem is broadly ascending; secondary branches grow at a 55° angle.

Phenology Initial leaf colour: purplish red-brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note In this study only poorly grown trees were found.





Ontario Code: DN 74

Populus deltoides x Populus nigra 'N3'

(A local hybrid)

Diagnostic Features:

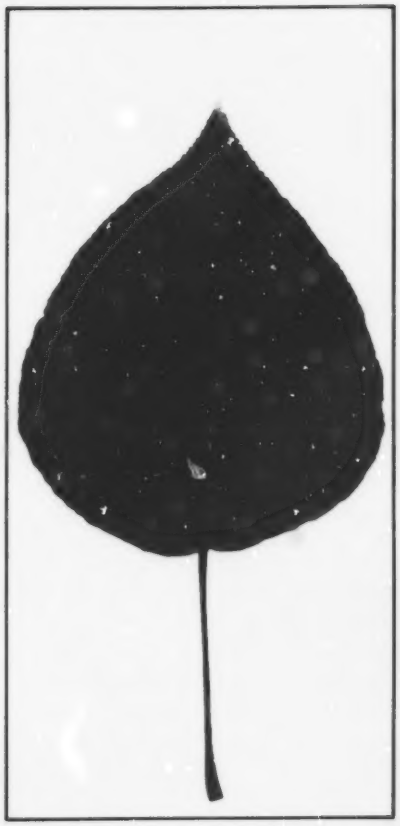
Leaf Tri-angled and as long as it is wide, with an acuminate tip. Broadly cuneate and unnotched base has glands present. Moderately serrate, somewhat hooked margin with no undulate. White midrib is at an 80° angle. Pale red petiole is half the length of the blade.

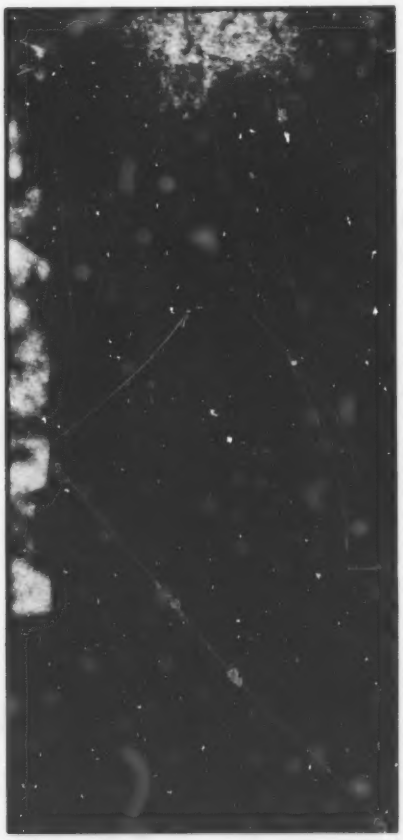
Bud Gummy, small, and one and a half times as long as it is wide. In shape, plump and pointed. Position to stem is appressed and leaning outward. Shape of leaf scar: class 5.

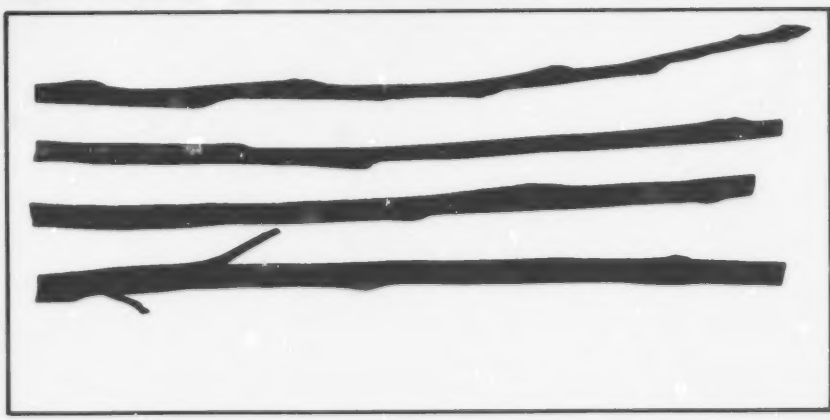
Twig In cross-section, angular with heavy ribs. Upper section dark mottled brown; lower section greenish grey. The lenticels are circular, large, well dispersed, and occasionally spotted below the scar. Position to stem is straight ascending at a sharp angle; short secondary branches grow at a 45° angle.

Phenology Initial leaf colour: light brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note The leader is often twisted and numerous swellings can be found on long shoots.







Ontario Code: Jackii 4

Populus balsamifera x Populus deltoides

(Open pollinated, local hybrid; there is some question as to its genetics.)

Diagnostic Features:

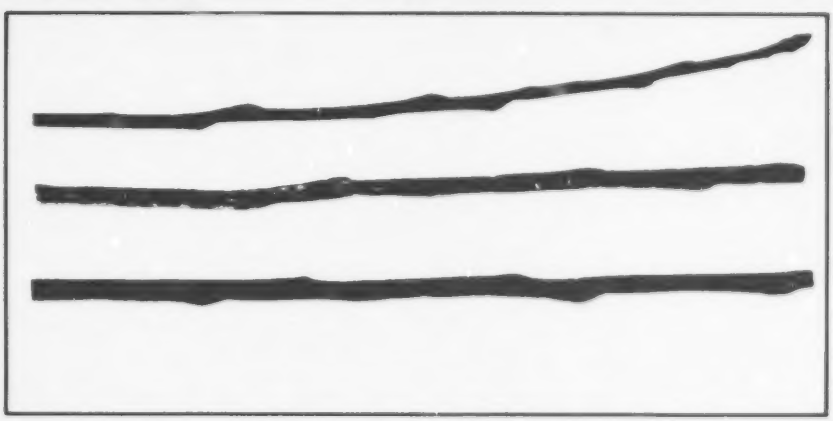
Leaf Ovate or elliptical and one and a half times longer than it is wide, with a pointed tip which is acute on a young leaf. Sharply cuneate or rounded base, occasionally feeble notched, with glands present. Fine, almost indistinctly serrate margin. Red midrib is at a 50° angle. Red petiole is very short, extending only one-third the length of the blade.

Bud Gummy, and three and a half times as long as it is wide. In shape, narrowly oblong, acute, and humpy at the base. Position to stem is appressed and leaning sideways. Shape of leaf scar: class 5.

Twig In cross-section, very angular with corky ribs. Upper section dark purplish brown and mottled; lower section greenish brown with light brown ribs. The lenticels are circular, widely dispersed, and small. Position to stem is broadly spreading; sylleptic and secondary branches are very common, occurring at a 55° angle.

Phenology Initial leaf colour: green. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note Shrubby growing trees.



Ontario Code: Jackii 30

Populus x deltoides 'Manitoba' Rol.

(An open pollinated clone)

Diagnostic Features:

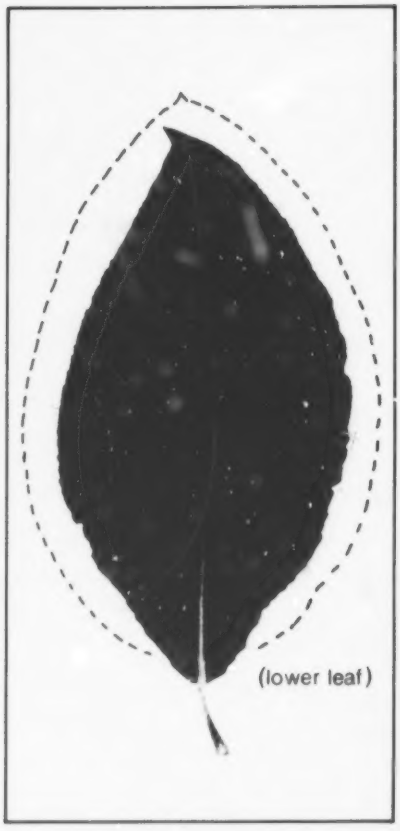
Leaf Deltoid or rhombo-deltoid and as long as it is wide, with a pointed tip. Broadly cuneate and feeble notched base. Serrate (hooked) margin has a slight undulate. White midrib is at a 70° angle. Dark red petiole is one-third of the blade length.

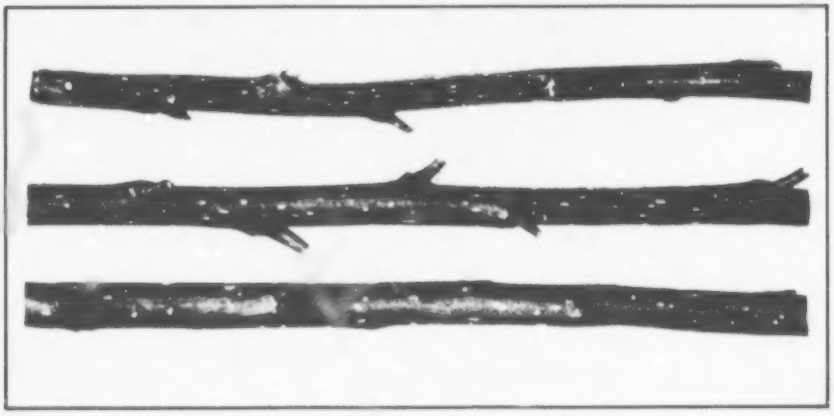
Bud Gummy and large, three times as long as it is wide. In shape, ovate, pointed, and husky. Position to stem is appressed. Shape of leaf scar: class 3.

Twig In cross-section, angular with strong ribs. Upper section dark reddish brown; lower section dark green with corky ribs. The lenticels are oblong, widely dispersed, and sometimes inconspicuous. Position to stem is broadly ascending; epicormic shoots are common in this species, occurring at a 35° angle.

Phenology Initial leaf colour: green. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note This is a very early defoliator and the leaders' growth begins early. Very few samples of this clone have been found and it can be considered a failure in Ontario conditions.


(lower leaf)



Ontario Code: Jackii 34

Populus maximowiczii x Populus trichocarpa Schrein. 'NE 388'

Diagnostic Features:

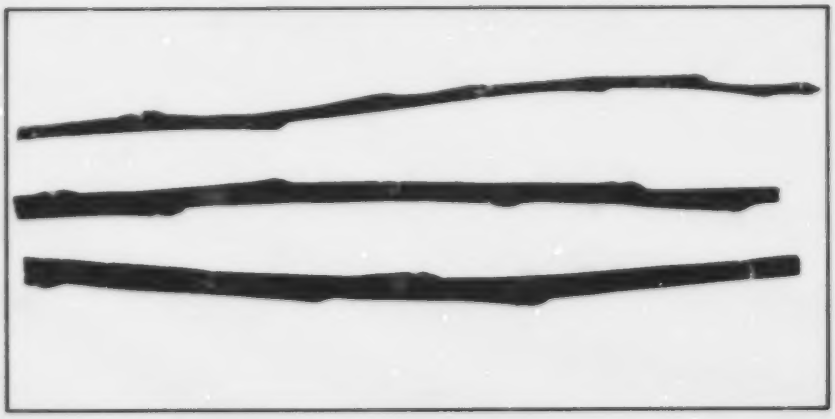
Leaf Oval and twice as long as it is wide, with a sharp, pointed tip. Cuneate, sometimes with a base covering, and rounded base. Very finely serrate margin with no undulation. White midrib is at a 50° angle; the lower surface is whitish and waxy. Pale red petiole (except in the autumn) is one-quarter the length of the blade.

Bud Large and three times as long as it is wide. In shape, narrowly oblong, acute, and concave. Position to stem is ascending. Shape of leaf scar: class 1.

Twig In cross-section, terete with feeble ribs. Upper section, dark purplish brown; lower section dark greenish brown. The lenticels are oblong and widely dispersed. Position to stem is straight ascending; fine branches and short secondary twigs occur at a 50° angle.

Phenology Initial leaf colour: green, with balsam deposits on the leaf. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note Numerous leaves develop from the axillary buds in August. Swellings are quite common on the shoots. The bud colour is distinctly dark purple. Jackii 34 leaves grow in clusters on short branches. They are usually shiny green, but are some of the first to turn yellow in the autumn.



Ontario Code: DTAC-1
No Common Name

(A clone of unknown origin)

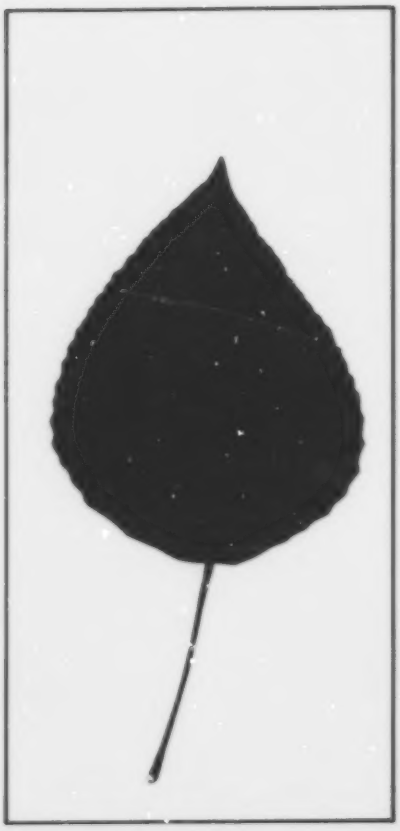
Diagnostic Features:

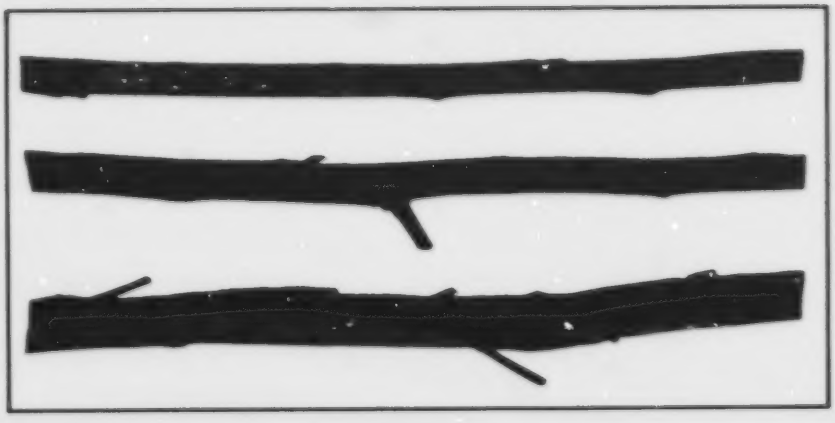
Leaf Tri-angled or deltoid and as long as it is wide, with a pointed tip. Straight to dent, feeble notched base with glands present. Serrate margin having a short-wave undulation. White midrib is at a 75° angle. Extremely red petiole is three-quarters the length of the blade.

Bud Not gummy to the touch and small, the bud is three times as long as it is wide. In shape, oval, sharp-pointed, humpy at the base; and the tip leans outwards. Position to stem is appressed. Shape of leaf scar: class 4.

Twig In cross-section, angular with fine ribs. Upper section purplish brown and mottled; lower section dark green. The lenticels are oblong, small, and densely dispersed. Position to stem is spreading and erect; leaders are forked or twisted and only a few secondary branches develop, at a 50° angle.

Phenology Initial leaf colour: brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.





Ontario Code: DTAC-2

Populus angulata x Populus berolinensis Schrein. 'NE 32'

Diagnostic Features:

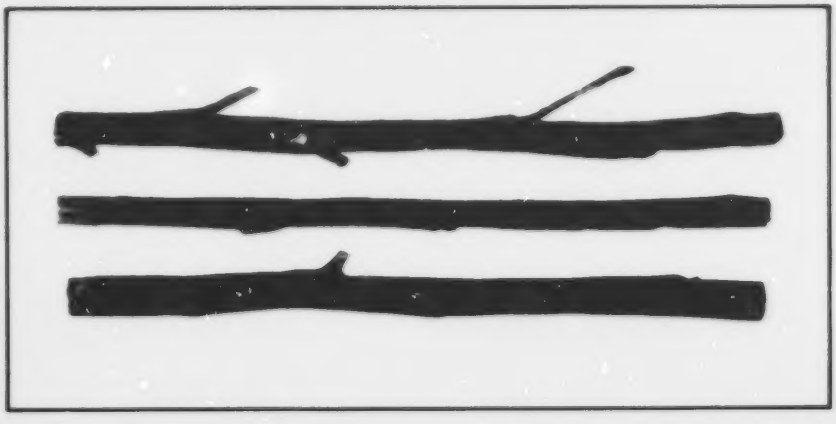
Leaf Ovate and longer than it is wide by a margin of one and a third, with an acuminate tip. Round with feeble notched base, with glands present. Finely serrate margin with a short-wave undulation. Red to pale red midrib is at a 65° angle. Red petiole is half the length of the blade.

Bud In size, three times as long as it is wide. Very gummy and light brown in colour. In shape, oblong, acute, and with a thin base bract. The bud leans sideways. Position to stem is ascending and concave. Shape of leaf scar: class 2.

Twig In cross-section, angular with corky ribs when lignified. Upper section light brown to greyish; lower section greyish brown. The lenticels are oval and sometimes inconspicuous on leaders. Position to stem is broadly ascending and spreading in the lower portion of the tree; sylleptic branchlets and dense secondary branches usually develop at a 50° to 60° angle in the crown portion.

Phenology Initial leaf colour: purplish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.

Note The brown buds contrast quite sharply against the greenish grey bark and the light beige to brown ribs.



Ontario Code: I-45/51

Populus x euramericana 'I-45/51' or 'Italian'

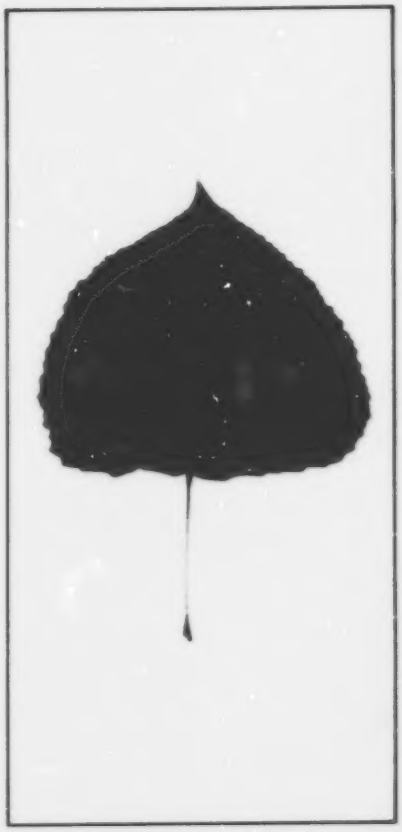
Diagnostic Features:

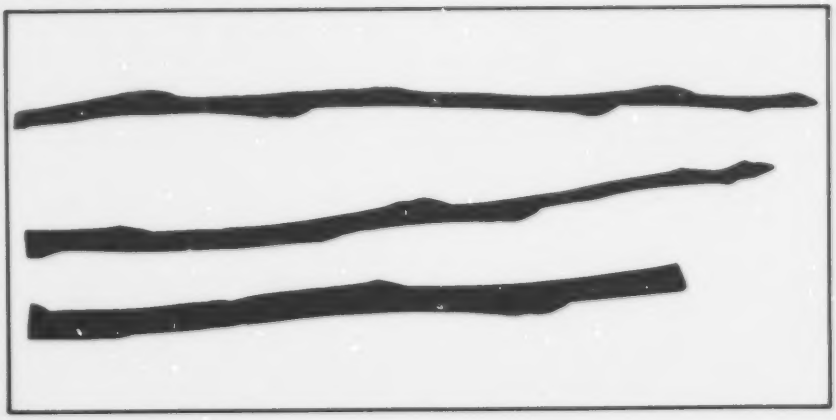
Leaf Deltoid and somewhat longer than it is wide and pointed at the tip. Cuneate to cordate base is feeble notched. Coarsely serrate, unhooked margin has a wide undulate. Pale red midrib is at an 85° angle. Pale red petiole is half of the blade length.

Bud Not gummy, large, and three times as long as it is wide. In shape, oval and acuminate. Position to stem is appressed and concave. Shape of leaf scar: class 5.

Twig In cross-section, strong angularity with the ribs. Upper section light greenish brown and mottled; lower section greyish brown. The lenticels are circular. Position to stem is spreading; sylleptic branchlets and secondary branches develop in the lower portion of the stem.

Phenology Initial leaf colour: brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.





Ontario Code: D 38

Populus deltoides Bartr., Belleville

Diagnostic Features:

Leaf	Deltoid and somewhat tri-angled and longer than it is wide, with an acuminate tip. Cuneate and notched base has glands present. Finely serrate margin has a slight undulate. Pale red midrib is at a 55° angle. Pale red petiole is two-thirds the length of the blade.
Bud	Not gummy and three times as long as it is wide. In shape oblong and acute. Position to stem is ascending with a concave tip. Shape of leaf scar: class 4.
Twig	In cross-section, strongly angular with ribs. Upper section greenish brown and mottled with yellow ribs; lower section grey or green-tinged grey. The lenticels are oblong and spotted below the leaf scars. Position to stem is curved ascending; prolific shoots develop in this species.
Phenology	Initial leaf colour: reddish brown. For flushing time, defoliation time, and terminal bud formation, see Appendix 3.
Note	This clone species performs poorly in plantations.

Appendix 1

Statistical Analysis of Leaves and the Use of 95% Confidence Intervals of Leaf Characteristics

How to Use Confidence Intervals of Measurement Data for Clone Classification

In order to determine the most variable characteristic of a leaf, coefficients of variation ($C\% = S_{\bar{x}}/\bar{x}$) were calculated for each of the following: leaf length, maximum leaf width, petiole length, angle between the midrib and main vein at the leaf base, leaf length/leaf maximum width, and petiole length/leaf length. On a relative basis, petiole length exhibited the most variation and appeared to be the best distinguishing characteristic with which to begin the classification of clones.

The 95% confidence interval ($I = \bar{x} \pm [1.96 \times S_{\bar{x}}]$) was calculated in order to find the ranges for each characteristic within each single clone. The study of range limits developed the possibility of determining the significant differences between clones and between characteristics, as well. The computed means of metric measurements for each single clone provided the proper estimation for the within-clone pooled variance S_p^2 which led to the calculation of the New Multiple Range Text, using the equation $S_{\bar{x}} = \sqrt{S_p^2/r}$. The ranges of characteristics are listed for the leaf characters of all clones in the enclosure.

In the classification procedure, the first step is to find the closest identity between the measured and the listed petiole-length interval in the second column of the following table. The next step is to locate the other variables, from column to column, within the defined petiole-length group. The highest number of new measurements matching with the confidence intervals furnishes the highest probability of identity. The success of this classification procedure depends on the number of samples measured.

95% Confidence Interval of Leaf Characteristics for 32 Selected Clones

Code	Petiole length in millimetres	Blade length in millimetres	Maximum blade width
Jackii 34	16.61-25.69	65.40-78.80	29.80-49.90
DN 15		65.62-72.78	70.54-77.86
DN 30	29.20-33.00	65.87-74.83	63.56-71.44
DN 70		53.26-59.84	49.66-57.84
DN 9		54.52-60.68	56.07-64.13
DN 21		60.16-68.34	67.10-74.80
DN 25		65.06-73.44	57.60-72.40
DN 28	33.10-39.00	79.03-86.47	75.69-82.91
DN 31		77.26-85.14	74.16-84.24
DN 36		70.65-80.35	64.29-73.91
DTAC-1		53.05-61.75	49.99-58.21
Jackii 30		86.53-92.68	85.35-96.67
DN 2		60.63-68.37	54.59-65.11
DN 5		65.30-76.40	60.02-72.88
DN 16		77.95-85.15	69.58-77.22
DN 19	39.10-45.00	53.77-60.53	55.49-64.01
DN 22		70.34-78.46	66.62-75.68
DN 33		82.60-91.10	80.25-88.35
DN 74		77.76-86.04	73.05-79.95
DN 34		72.66-79.14	72.37-80.93
DTAC-2		78.80-90.70	61.96-72.64
Jackii 4		74.55-81.85	50.89-58.11
I-45/51		78.42-88.38	71.92-83.08
DN 1		81.22-91.18	85.86-97.04
DN 7		69.07-83.15	78.97-82.53
DN 14		78.04-85.86	81.75-90.85
DN 17	45.10-51.00	66.30-72.40	59.81-70.79
DN 38		69.69-76.61	58.94-70.76
D 38		72.00-76.40	63.00-72.00
DN 55		63.04-73.26	70.64-81.30
DN 10	51.10-58.00	75.35-86.45	74.16-88.74
DN 18		89.30-103.30	78.50-95.00

Based on 20 Samples of One- to Two-Year-Old Nursery Stock

Vein Angle d°	Leaf Length/ Leaf Width	Petiole Length/ Leaf Length
37.00-42.20	1.672-2.016	0.228-0.294
70.42-75.28	0.915-0.958	0.463-0.491
73.79-79.21	1.011-1.073	0.459-0.517
67.09-70.51	1.009-1.123	0.486-0.548
72.40-83.90	0.932-0.994	0.590-0.700
74.54-79.86	0.878-0.932	0.496-0.540
78.94-87.36	1.027-1.113	0.456-0.566
74.75-77.15	1.016-1.075	0.400-0.428
74.16-84.24	0.990-1.068	0.408-0.466
77.45-86.05	1.068-1.126	0.438-0.474
71.56-82.94	1.015-1.121	0.557-0.667
76.26-80.93	0.979-1.027	0.392-0.420
57.44-68.96	1.040-1.154	0.589-0.679
60.10-67.04	1.018-1.148	0.541-0.607
78.49-82.31	1.091-1.138	0.478-0.506
71.13-79.67	0.915-1.017	0.688-0.790
75.90-81.40	1.008-1.098	0.571-0.618
81.67-85.83	1.001-1.063	0.434-0.470
76.85-85.84	1.032-1.114	0.509-0.584
55.67-60.55	0.962-1.032	0.528-0.575
55.28-64.72	1.217-1.319	0.443-0.497
45.38-52.62	1.391-1.505	0.502-0.588
85.51-91.69	1.053-1.123	0.486-0.548
52.20-62.04	0.922-0.966	0.532-0.579
57.36-63.52	1.000-1.052	0.517-0.561
88.53-90.37	0.934-0.969	0.558-0.598
62.97-75.13	1.022-1.144	0.631-0.705
64.86-71.84	1.075-1.247	0.628-0.722
52.50-64.30	1.049-1.191	0.626-0.680
79.40-82.70	0.867-0.929	0.621-0.773
68.76-80.74	0.942-1.079	0.689-0.767
66.72-85.38	1.068-1.190	0.511-0.617

Appendix 2

Rating and Systemization of Diagnostic Features for the Producers of Poplar Clones

Punch Card for Recording Rated Characteristics

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
a																	
b																	
c																	
d																	
e																	
f																	

	18	19	20	21	22	23	24	25	26	27	28	29	30	CLONE: CODE NO.
a														
b														
c														
d														
e														
f														

Explanation of Symbols and Ratings Prepared for the Punch Card

Leaf

1. Midrib length.
   a 60 mm or less
   b 61-70
   c 71-80
   d 81-90
   e 91-100
   f 101 mm or more

2. Maximum leaf width.
   a 60 mm or less
   b 61-70
   c 71-80
   d 81-90
   e 91 mm or more

3. Leaf length/leaf width quotient.
   a 0.900 or less
   b 0.901-1.000
   c 1.001-1.100
   d 1.101-1.200
   e 1.201-1.300
   f 1.301 or more

4. Petiole length/leaf length quotient.
   a 0.400 or less
   b 0.401-0.500
   c 0.501-0.600
   d 0.601-0.700
   e 0.701 or more

5. Angle between main vein (midrib) and lowest side vein.
   a 60° or less
   b 61° to 70°
   c 71° to 80°
   d 81° to 90°
   e 91° or more

6. Tip of leaf.
   a pointed
   b acuminate
   c acute

7. Leaf base.
   a indent
   b straight
   c broadly cuneate
   d cuneate
   e round

8. Incision of base.
   a nil
   b slight
   c definite
   d sharp
   e base covering

9. Petiole length.
   a 30 mm or less
   b 31-35
   c 36-40
   d 41-45
   e 46-50
   f 51 mm or more

10. Leaf shape.
    a ovate
    b oval
    c rhomboid
    d deltoid
    e elliptical

11. Leaf margin.
    a finely serrate
    b serrate
    c coarsely serrate

12. Midrib colour.
    a white
    b pale red
    c red
    d very red
    e dark red

13. Petiole colour.
    a white
    b pale red
    c red
    d very red
    e dark red

Bud

14. Length/width quotient.
    a 1.6-2.0
    b 2.01-2.25
    c 2.26-2.50
    d 2.51-3.00
    e 3.01 or more

15. Length.
    a 4 mm or less
    b 5-6
    c 7-8
    d 9-10
    e 11 mm or more

16. Shape.
    a plump
    b oval
    c oblong
    d narrowly oblong

17. Tip.
    a obtuse
    b pointed
    c acuminate
    d sharp pointed, acute

18. Position of stipules.
    a appressed
    b ascending
    c outcurved
    d spreading

19. Time of flushing.
    a early
    b simultaneous to DN 34
    c late
    d very late

20. Terminal bud formation.
    a early
    b simultaneous to DN 34
    c late
    d very late

21. Time of defoliation.
    a early
    b simultaneous to DN 34
    c late
    d very late

22. Period of defoliation.
    a short
    b moderate
    c long

23. Leaf colour at defoliation.
    a discoloured green
    b transitional between green and yellow
    c yellow

24. Appearance of rust.
    a spotty
    b evenly but not densely dispersed
    c fully covered

25. Shape of leaf scar (types 1 to 6).
    a narrowly crescent
    b half round
    c triangular with transverse ridges
    d half elliptical
    e crescent with sharp protrusion (types 5 and 6)

Stem

26. Cross-section of leader.
    a terete
    b angular
    c angular with ribs

27. Cross-section of lower section.
    a terete
    b terete and ribbed
    c feeble angular and ribbed

28. Branch position to stem.
    a ascending with sharp angle
    b curved at axis and ascending
    c spreading and ascending
    d spreading
    e fastigiate

29. Colour of terminal shoot.
    a brown
    b light brown
    c greenish brown
    d reddish brown
    e dark reddish brown
    f purplish brown

30. Irregularities.
    a nil
    b axillary leaves, two to four, growing from the scar in the autumn
    c sylleptic branches
    d swellings
    e others

Appendix 3

Dates of Flushing, Terminal Bud Formation, and Defoliation

For maximum information, trees have to be observed in each of the different seasons. Variations in leafing phases concerning the date of bud burst to the completion of flushing indicate that segregation among clones is possible. There are early- or late-flushing clones, and the length of flushing periods is also distinguishable—for example, Jackii 34 is the earliest and DN 74 is the latest flushing clone. Flushing date is delayed about seven days in the northeastern region of Ontario. The timing of leafing is controlled by variable ecological conditions, but mainly by temperature. Early hot spells or heavy, late frosts will greatly affect the phases of the leafing process.

Significant data regarding the active period of growth and the onset of dormancy can be furnished by a careful assessment of terminal bud formation. Variability in the length of bud-formation periods normally results in marked differences in total seasonal increment and frost hardiness. Observations of terminal bud formation should begin in the middle of August and continue until the end of September. Divergency in bud formation among several identical clones growing at various locations is perhaps attributable to the age-class differences of trees and to adverse conditions of one particular site.

Defoliation dates are extremely variable for the selected clones in this survey. The rate of defoliation depends a great deal upon the susceptibility towards rust infestation, the ecological condition of a given site or sites, and the genetic make-up of a new hybrid. There are some indications that an excess of available nitrogen in the soil delays the onset of dormancy. Furthermore, interclonal diversity in physiological functions can develop among ramets of a single clone, with the differences appearing to be associated with mechanical injury or attack by disease and insects.

With these thoughts in mind, the following table is a list of the usual dates of flushing, terminal bud formation, and end of defoliation of the thirty-two clones examined in this study.

Dates of Flushing, Terminal Bud Formation, and Defoliation

Flushing Time			Terminal Bud Formation			End of Defoliation		
Earlier	May 1-5*	Later	Earlier	August 20-30*	Later	Earlier	October 20-25*	Later
DN 1	DN 2	DN 9	DN 2	DN 1	DN 22	DN 2	DN 1	DN 10
DN 4	DN 5	DN 16	DN 10	DN 5	DN 25	DN 5	DN 7	DN 16
DN 7	DN 15	DN 19	DN 17	DN 7	DN 28	DN 15	DN 9	DN 17
DN 10	DN 18	DN 74	DN 74	DN 9	DN 30	DN 18	DN 14	DN 22
DN 14	DN 28		DTAC-2	DN 14	DN 31	Jackii 4	DN 19	DN 25
DN 17	DN 30			DN 15	DN 33	Jackii 30	DN 21	DN 28
DN 21	DN 31			DN 16	DN 36	DTAC-2	DN 33	DN 30
DN 22	DN 34			DN 18	DN 38		DN 34	DN 31
DN 25	DN 38			DN 19	DN 55		DN 36	DN 70
DN 33	DN 55			DN 21	DN 70		DN 38	Jackii 34
DN 36	DN 70			DN 34	Jackii 4		DN 55	DTAC-1
Jackii 30	DTAC-1				Jackii 30		DN 74	I-45/51
Jackii 34	D 38				Jackii 34		D 38	
DTAC-2					DTAC-1			
I-45/51					I-45/51			
					D 38			

* All clones listed in these columns are simultaneous with DN 34.

Glossary

Acute Short and pointed, as applied to a bud; sharp tip of leaf.

Acuminate long and pointed, as applied to a bud and leaf tip.

Angular Sharp cornered, as applied to a twig and branch.

Appressed Bud close or flat against the stem.

Ascending Slope upwards, as applied to a bud and branch.

Base Covering Rounded lobe covering the opposite lobe at leaf base, as applied to cordate, heart-shaped leaves.

Bract A modified leaf subtending the base of a bud.

Bud Scale The modified protective leaf of a bud.

Bundle Traces The place on a leaf scar where the woody strands pass from the stem into the leaf.

Canker A disease of poplars that causes decay or rot of the bark and wood.

Cilia Small, hairlike processes extending from certain cells, forming a hairy surface.

Clone Trees reproduced asexually from a common ancestor and having identical genetic constitutions.

Cordate Heart-shaped; refers to a leaf base with two rounded lobes.

Cuneate Wedge-shaped leaf base, jutting out of the blade.

Cultivar A new plant developed in cultivation through an asexual breeding program and propagated by vegetative plant parts.

Deltoid Triangular; delta-like, with equal sides.

Dent, Dentate Toothlike projection; form of deep recess towards midrib on the leaf base.

Downy Covered with fine, fluffy, short hairs.

Feeble Notch Slender V-shaped cut at the tip of a leaf.

Fissured Having narrow openings or cracks along the length of the bark.

Furrowed Having grooves along the length of the bark.

Glabrous Smooth; lacking in hairs.

Gland A modified epidermic cell, extended to a hairlike extrusion and secreting a liquid the cell manufactures.

Glaucus Covered with a thin layer of whitish powder that can be rubbed off.

Gummy Having a balsam exudation on the outer surface of the bud.

Heterophilia Condition of growing leaves of different forms on the same stem.

Humpy Having a protuberance of base scale, as applied to buds.

Hybrid A progeny resulting from the cross-fertilization of one *Genus, species* or variety of plant with another, different, plant.

Incision-Notch Cutting into the leaf base; usually wedge-shaped.

Leaf Scar Scars on a twig from which leaves have fallen.

Lenticel A wart-like prominence protruding through the bark of a young twig.

Linear Long and uniformly narrow, as applied to leaves; nearly straight, as applied to leaf scars.

Lobed Divided rather deeply, as applied to leaves.

Midrib The prominent central vein of a leaf.

Outcurved As applied to a bud, deviating outward from the stem.

Oval As applied to a leaf or a bud, broad-elliptical, about one and a half times as long as broad, and round at the base.

Ovate Having an outline like that of an egg, as applied to a leaf or a bud.

Petiole The leaf stalk.

Pubescent Hairy.

Rhomboid Quadrilateral with opposite sides and angles equal.

Serrate Saw-toothed with the teeth pointing upward, not necessarily hooked.

Species A class of individual plants, usually interbreeding freely and having many characteristics in common; a category of botanical classification.

Sunscald A crack on the juvenile bark, caused by much sun exposure, usually infected with certain fungi or bacteria.

Sylleptic Twig A short, secondary branchlet developing from the leaf axil between the petiole of a leaf and the stem in August or later.

Terete Round in cross-section, as applied to a twig or a branch.

Translucent Said of the thin leaf-margin tissue that transmits light but is transparent.

Variety Individuals within a species with different morphologic and phenotypic characteristics. Abbreviated 'var'.

Whorl A circle of several branches or limbs growing around a central point of the whip or the upper portion of a stem or or trunk.

About the Author

Dr. Kalman J. Roller, R.P.F., an eminant Hungarian educator and scientist with over forty years of service in the forestry profession, holds a B.Sc. in forest engineering, an M.Sc. in plant genetics, and a Ph.D. in forestry. He has done work in Hungary (where, among other things, he was Dean of the Faculty of Forestry at Sopron), in Holland, in Colombia, South America, and in Canada.

Elected to the National Science Foundation as an authority on *Genus Abies* in North America, Dr. Roller is the author of more than one hundred scientific papers as well as a textbook on seeding and planting practices.

Since emigrating to Canada in 1956, Dr. Roller has done extensive work on the establishment of poplar plantations in Manitoba, New Brunswick, and Ontario. Because of his unique background, he was invited, in 1980, to undertake the identification of 32 poplar clones in Ontario. The research involved in that project led directly to the publication of this guide.